Welding Engineer

PIONEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

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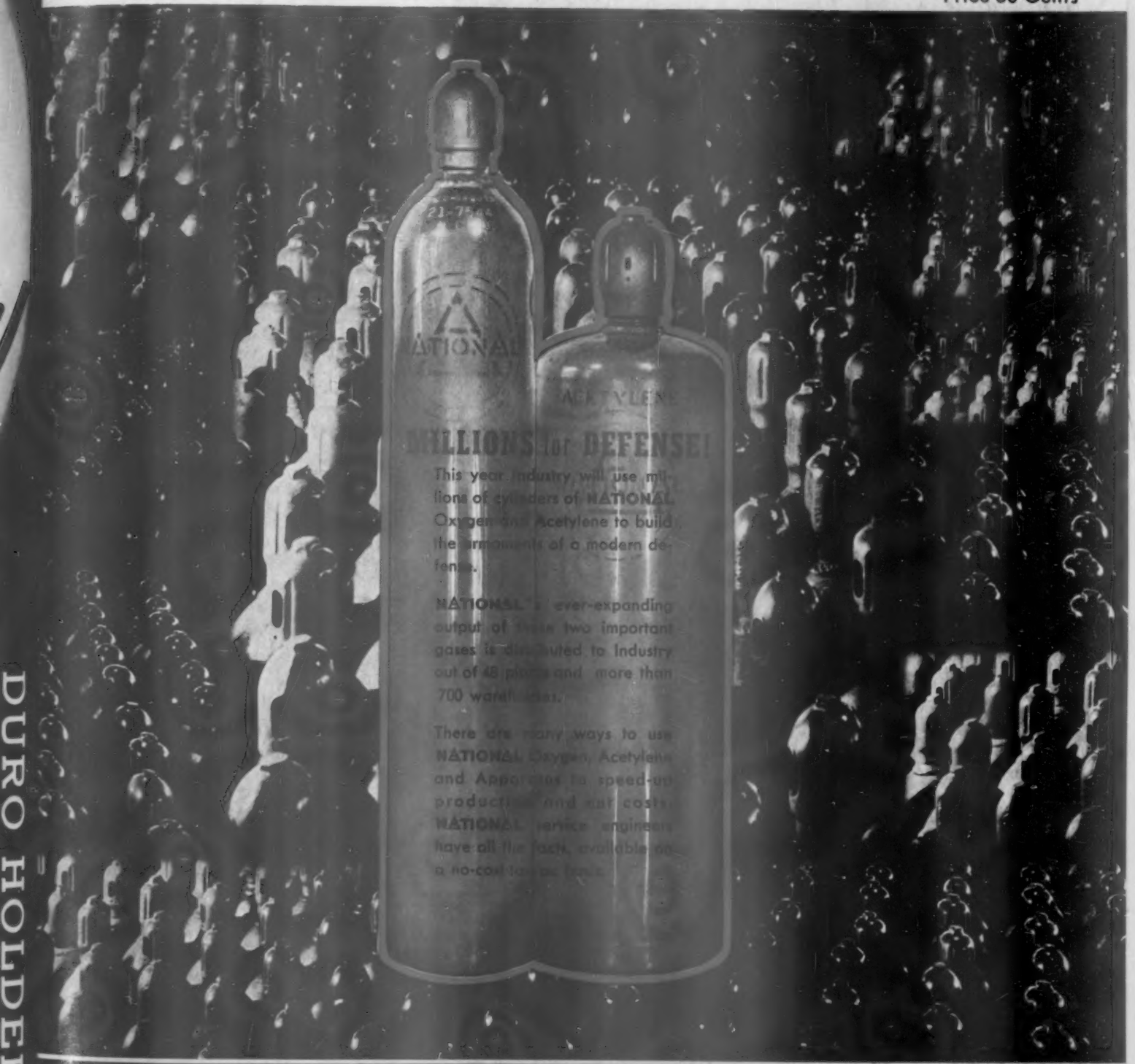
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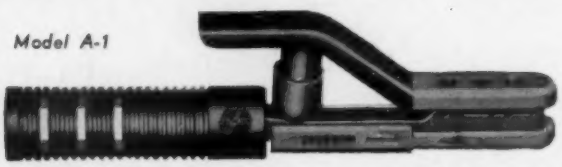
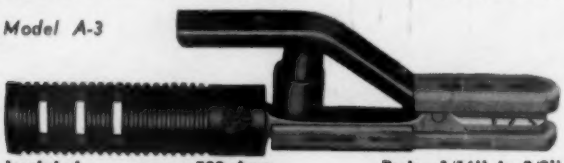


Insulated Stationary Jaws — 300 Amp. — Rods—1/16" to 1/4" — Weight 22 oz.

Model A-2

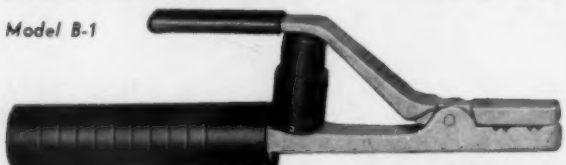
Insulated Replaceable Jaws of Mallory 3 Metal — 300 Amp. — Rods—1/16" to 1/4" — Weight 22 oz.

Model A-3



Insulated Replaceable Jaws of Mallory 3 Metal — 500 Amp. — Rods—1/16" to 3/8" — Weight 27 oz.

Model B-1



Non-Insulated Stationary Jaws — 300 Amp. — Rods—1/16" to 1/4" — Weight 18 oz.

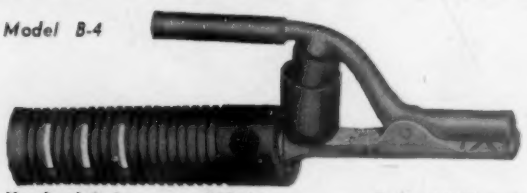
Model B-2

Non-Insulated Replaceable Jaws of Mallory 3 Metal — 300 Amp. — Rods—1/16" to 1/4" — Weight 19 oz.

Model B-3

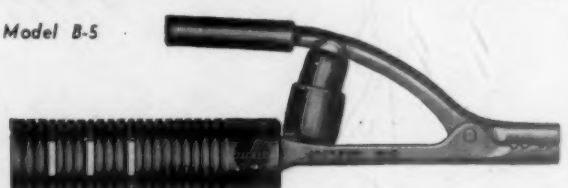
Non-Insulated Replaceable Jaws of Mallory 3 Metal — 500 Amp. — Rods—1/16" to 3/8" — Weight 24 oz.

Model B-4



Non-Insulated All Mallory 3 Metal — 200 Amp. — Rods—1/16" to 3/16" — Weight 15 oz.

Model B-5



(Same as B-4 except it is 1-1/4" longer.) Length—10-3/8" — Weight 16 oz.

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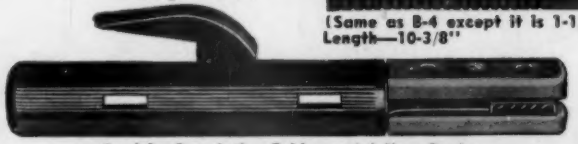

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Model F-5 — 500 Amps. — Rods 1/16" to 3/8" — Wt. 27 oz.

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The Welding Engineer

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American Welding Society
International Acetylene Association

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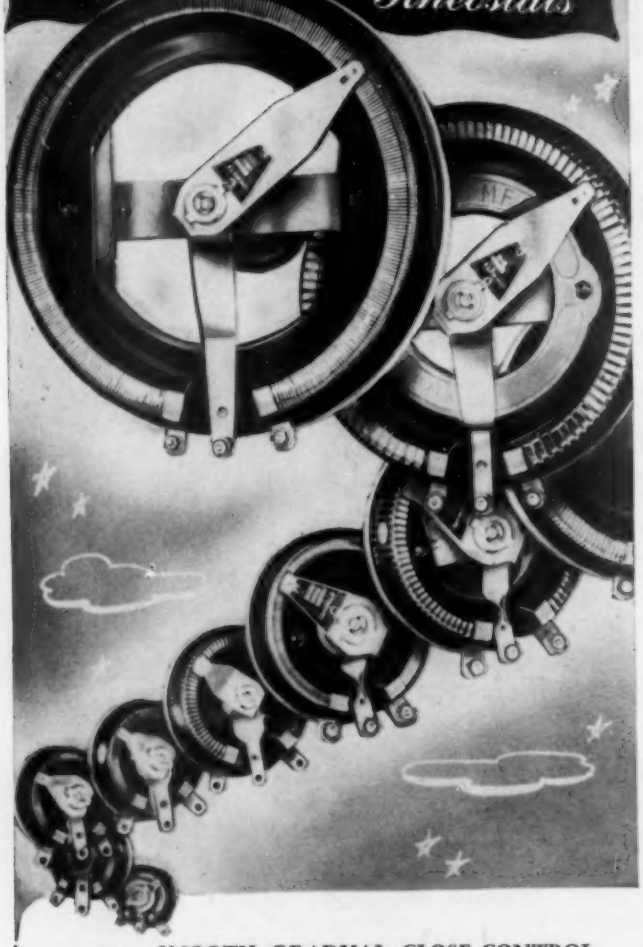

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The American Welding Society Goes to Philadelphia

Sixty-six papers have been scheduled for the 22nd Annual Meeting of the Society. The meetings will be held at the Bellevue-Stratford Hotel

"Lest We Forget"

FOR the first time in 13 years, the welding engineers and production men will convene in Philadelphia for an annual meeting of the American Welding Society. The 22nd Annual Meeting of the American Welding Society will be held at the Bellevue-Stratford Hotel in Philadelphia the week of October 19th. The tentative program with its 66 papers covering all phases of welding, will be the largest ever planned for a meeting of the American Welding Society. This meeting is being held simultaneously with the meetings of the American Society for Metals, the Wire Association, Iron and Steel Division, and Institute of Metals Division, American Institute of Mining and Metallurgical Engineers.

The activities of the week will begin with the President's Reception which will be held in the North Garden at the Bellevue-Stratford Hotel Sunday evening, October 19th.

The Annual Meeting will be called to order Monday morning, October 20th, by Col. G. F. Jenks, President of the American Welding Society. Following the presentation of medals and prizes, the first technical session will begin. This session will be on the Weldability of Plain Carbon and Low-Alloy Steels with Mr. O. B. J. Fraser and Mr. C. H. Jennings as Co-Chairmen. At this session there will be presented three technical papers.

Beginning Monday afternoon there will be simultaneous technical sessions every day of the meeting, both morning and afternoon, with the exception of Thursday afternoon. No technical sessions have been scheduled for Thursday afternoon so that the welding men attending the annual meeting might have time to visit the exhibits of the National Metal Congress and Exposition which is being held at Philadelphia Public Auditorium. The various technical sessions which are being held will cover research, shipbuilding, training, railroad, testing methods, automotive and aircraft welding, structural welding, resistance welding, metallurgy, machinery, pressure vessels and pipe welding and National Defense welding.

The annual banquet will be held at 7 P.M. Thursday evening in the ballroom of the Bellevue-Stratford. Continuing the policy adopted at last years' convention, there will be no principal speaker but the dinner banquet guests will be entertained by a show troupe following the dinner, after which there will be dancing.

The business meeting of the Society at which the President will give his annual report and the election and installation of the 1941-42 officers will take place at 11:30 Friday morning. Immediately following the business meeting there will be held a luncheon for the Board of Directors of the Society, thus closing a highly informative week of welding progress in the City of Brotherly Love.

On the following pages will be found a complete technical program of the 22nd Annual American Welding Society Meeting in Philadelphia.

Program for the 22nd Annual A. W. S. Meeting

Philadelphia, Oct. 19-24, 1941

SUNDAY, OCTOBER 19th, 5 to 7 P.M.

PRESIDENT'S RECEPTION

MONDAY, OCTOBER 20th

9:30 A.M.—Morning—Opening Session

Co-Chairmen: G. F. JENKS, President, American Welding Society. E. V. DAVID, Chairman, Convention Committee.

PRESENTATION OF MEDALS AND PRIZES

10:15 A.M.—Technical Session

WELDABILITY OF PLAIN CARBON AND LOW-ALLOY STEELS

Co-Chairmen: O. B. J. FRASER, Chairman, Meetings and Papers Committee. C. H. JENNINGS, Westinghouse Electric & Manufacturing Company.

"The Specification of Weldability of Steels," by A. B. KINZEL, Union Carbide and Carbon Res. Labs.

"Weldability Tests of Nickel Steels," by C. E. JACKSON and G. G. LUTHER, Naval Research Lab.

"Weldability of Steels," by W. H. BRUCKNER, University of Illinois.

OPENING METALS EXPOSITION

12:00 Noon

2:00 P.M.—Monday Afternoon—Simultaneous Technical Sessions

RESEARCH—NON-FERROUS

Co-Chairmen: J. R. DAWSON, Union Carbide & Carbon Res. Labs. R. B. SWOPE, Southern Oxygen Company.

"Study of the Effect of Core Wire Temper on the Quality of Welds in Monel, Nickel and Inconel," by F. G. FLOCKE, and K. M. SPICER, The International Nickel Co., Inc.

"The Flow of Metal in Brazing Aluminum," by DR. M. A. MILLER, Aluminum Research Labs.

"Welding of Copper," by A. P. YOUNG, Michigan College of Mining & Technology.

"Spot Welding of Nickel and Its Alloys," by W. F. HESS and ALBERT MULLER, Rensselaer Polytechnic Institute.

SHIPBUILDING

Co-Chairmen: DAVID ARNOTT, American Bureau of Shipping. T. M. JACKSON, Sun Shipbuilding & Dry Dock Co.

"Riveted vs. Welded Galvanized and Corrosion Resisting Steel Smoke Pipes," by H. O. KLINKE, U. S. Navy Yard.

"Machine Flame Cutting in Ship Construction," by E. R. MCCLUNG and H. L. WAGENER, New York Shipbuilding Corp.

"Survey of Welding and Cutting in Ship Construction," by F. G. OUTCALT and J. M. KEIR, The Linde Air Products Company.

"Welding Applications in Naval Machinery," by H. W. HIEMKE and J. D. BERT, Navy Department, Bureau of Ships.

TRAINING

Co-Chairmen: A. G. BISSELL, Bureau of Ships, Navy Dept. A. F. DAVIS, The Lincoln Electric Company.

Roundtable discussion on "Training of Welding Operators," led by A. G. BISSELL.

"A. W. S. Minimum Requirements for the Training of Welding Operators," by A. B. WRIGLEY, Chairman of Committee.

"Training Welders for National Defense," by JAMES A. WALN, Agent, Trade and Industrial Education, Defense Training Program, U. S. Office of Education.

"Training of Oxyacetylene Welding and Cutting Operators," by D. E. ROBERTS, The International Acetylene Association.

7:30 P.M.—Evening

"Industrial Research Conference," G. F. JENKS, Chairman, presiding.

TUESDAY, OCTOBER 21st

9:30 A.M.—Morning—Simultaneous Technical Sessions

FUNDAMENTAL RESEARCH—ARC STUDIES AND HEAT FLOW

Co-Chairmen: F. C. FYKE, Standard Oil Development Co. H. R. SALISBURY, Air Reduction Sales Co.

"Magnetic Arc Blow," by C. H. JENNINGS and A. B. WHITE, Westinghouse Electric & Mfg. Co.

"Metal Transfer in the Metallic Arc," by L. J. LARSON, Consulting Engineer.

"Heat Flow in Arc Welding," by F. M. MAHLA, M. C. ROWLAND and G. E. DOAN, Lehigh University.

RAILROAD

Co-Chairmen: A. G. OEHLER, Associate Editor, *Railway Age*. J. W. SHEFFER, American Car & Foundry Company.

"Welding as Applied to Locomotive," by JAMES PARTINGTON, American Locomotive Company.

"Design of the World's Largest Welded Flat Car," by H. M. PRIEST, Railroad Research Bureau.

"Welding Locomotives," by A. J. RAYMO, Baldwin Locomotive Co.

"Pressure Butt Welding of Railroad Rails," by LEM ADAMS, Oxweld Railroad Service Co.

2:00 P.M.—Tuesday Afternoon—Simultaneous Technical Sessions

FUNDAMENTAL RESEARCH—TESTING METHODS

Co-Chairmen: H. C. BOARDMAN, Chicago Bridge and Iron Co. E. J. BRADY, Alloy Rods Corporation.

"Weld Inspection by Means of Infra Red Light," by Prof. W. T. TIFFIN, University of Oklahoma.

"Evaluating Welded Joints," by PROF. W. F. HESS, Rensselaer Polytechnic Institute.

"Methods of Testing Spot Welds," by R. E. BOWMAN, War Department, Air Corps.

"Thermal Gradients in Spot-Welding Electrodes," by DR. F. R. HENSEL, E. I. LARSEN and E. F. HOLT, P. R. MALLORY & Co.

AIRCRAFT AND AUTOMOTIVE

Co-Chairmen: C. L. EKSERGIAN, Budd Wheel Company. PETER ALTMAN, Vultee Aircraft, Inc.

Col. G. F. Jenks, President and President-elect of the American Welding Society

"Automotive Welding," by S. M. SPICE, Buick Motor Division, VAUGHN FEGLEY, A-C Spark Plug Co., and L. M. SKIDMORE, General Motors Institute of Technology.
"Production and Quality Control in Aluminum Alloy Spot Welding," by P. H. MERRIMAN, The Glenn L. Martin Company.
"Welding in the Aircraft Industry," by FRANK SMITH, Stout Skycraft, Inc.
"Condenser Discharge Welding of Aluminum Alloys," by JOHN W. DAWSON, Raytheon Mfg. Co., and B. L. WISE, Federal Machine & Welder Co.

STRUCTURAL

Co-Chairmen: H. W. LAWSON, Bethlehem Steel Company. W. F. CARSON, Consulting Engineer.
"Structural Welding," by VAN RENSSELAER P. SAXE, Consulting Engineer.
"Design of a Welded Bridge," by G. T. HORTON, Chicago Bridge & Iron Co.
"Adapting Design and Construction Methods to Welding," by LAMOTTE GROVER, Air Reduction Sales Company.
"Cleveland Liquefied Gas Storage Tanks," by J. O. JACKSON, Pittsburgh-Des Moines Steel Co.
"Bridge Welding," by T. H. GARDNER, Florida East Coast Railway.

7:30 P.M.—Evening

FUNDAMENTAL RESEARCH CONFERENCE
H. C. BOARDMAN, Chairman, presiding

WEDNESDAY, OCTOBER 22nd

9:30 A.M.—Morning—Simultaneous Technical Sessions

RESEARCH—STRUCTURAL

Co-Chairmen: K. L. HANSEN, Harnischfeger Corporation. G. V. SLOTTMAN, Air Reduction Sales Company.
"Tests of Miscellaneous Types of Welded Building Connections," by BRUCE JOHNSTON and G. R. DEITS, Lehigh University.
"An Investigation of Welded Connections for Axially Loaded Angle Members," by G. J. GIBSON and B. T. WAKE, American Bridge Company.

AUTOMOTIVE AND AIRCRAFT

Co-Chairmen: CARL DEGANAHL, Fleetwings, Inc. J. D. TEBBEN, P. R. Mallory & Co.
"Welding in Aircraft Construction and Maintenance," by A. K. SEEMANN, The Linde Air Products Co.
"Management Control of Design and Welding of Aircraft," by J. P. DODS, Summerill Tubing Co.
"A Survey of Aircraft Resistance Welding Equipment," by L. P. WOOD, Curtiss-Wright Corp., Airplane Division.

2:00 P.M.—Wednesday Afternoon—Simultaneous Technical Sessions

RESISTANCE WELDING SYMPOSIUM

Co-Chairmen: L. W. CLARK, The Detroit Edison Company. R. E. POWELL, Western Electric Company.
"Structural and Metallurgical Properties of the Condensor Discharge Spot Welds," by G. S. MIKHALAPOV and T. F. FALLS, Taylor Winfield Corp.
"Pulsation Welding of Heavy Structures," by O. C. FREDERICK and R. P. MCCANTS, General Electric Co.
"The Electrical Characteristics of Resistance Welders and Proximity Effect of Magnetic Work Materials," by J. H. COOPER, Taylor Winfield Corp.
"Power Control," by H. R. CRAGO, General Electric Company.
"Forging Welding," by L. M. BENKERT, Progressive Welder Company.
"Spot-Welding Control and Supervision," by J. R. FETCHER, E. G. Budd Mfg. Co.

FUNDAMENTAL RESEARCH—METALLURGICAL

Co-Chairmen: H. O. HILL, Bethlehem Steel Company. MILTON MALE, U. S. Steel Corporation of Delaware.
"The Effect of Plate Temperature and Variable Wind Velocities on Properties of Carbon-Steel Metal Arc Welds," by JOHN L. MILLER, Firestone Tire and Rubber Co. and E. L. KOEHLER, Illinois Institute of Technology.
"Welding Aluminum Containing Steels," by C. E. SIMS and F. B. DAHLE, Battelle Memorial Institute.
"The Tee Bend Test as a Method of Determining Weldability of Steel," by G. A. ELLINGER, U. S. Bureau of Standards, A. G. BISSELL, Bureau of Ships, Navy Dept., and M. L. WILLIAMS, U. S. Bureau of Standards.
"Notch Sensitivity of Welds Under Repeated Loading," by H. L. DAASCH, University of Vermont.

NATIONAL DEFENSE

Co-Chairmen: E. A. DOYLE, The Linde Air Products Company. C. A. LOOMIS, Bureau of Ships, Navy Department.
"Temperature Brazing Instructors for Defense," by LEO EDELSON, Handy & Harman.
"Billet Cutting for Steel Forgings," by H. E. ROCKEFELLER, The Linde Air Products Co.
"Machine Cutting in National Defense Work," by R. F. HELMKAMP and A. H. YOCH, Air Reduction Sales Company.

THURSDAY, OCTOBER 23rd

9:30 A.M.—Morning—Simultaneous Technical Sessions

RESISTANCE WELDING

Co-Chairmen: J. D. GORDON, Taylor Winfield Corporation. E. C. SMITH, National Electric Welding Machines Co.
"Surface Polish and Contact Resistance," by W. B. KOUWENHOVEN, Prof. of Elec. Eng. and J. TAMPICO, Dr. Eng., The Johns Hopkins Univ.
"Structural Spot-Welding Consistency Control Methods," by A. M. UNGER, Pullman-Standard Car Mfg. Co.
"Electrical Measurement of Electrode Pressure During Spot Welding," by W. F. HESS and L. DANIEL RUNKLE, Rensselaer Polytechnic Institute.

MACHINERY

Co-Chairmen: C. I. MACGUFFIE, General Electric Company. A. J. RAYMO, Baldwin Locomotive Works.
"Flame Hardening Internal and External Round Surfaces," by STEPHEN SMITH, Air Reduction Sales Company.
"Uses of Flame-Hardening in Machine-Tool Production," by A. L. HARTLEY, R. K. LeBlond Machine Tool Co.
"Welding from the Foundryman's Point of View," by J. J. CURRAN, Research Metallurgist and T. H. BOOTH, Asst. Supt. Greenburg Works, Walworth Co.

2:00 P.M.—Afternoon

COMMITTEE MEETINGS
AND
DISTRICT AND SECTION OFFICERS CONFERENCE

No technical sessions are scheduled in order that the A. W. S. members and guests may have time to leisurely view the exhibits.

7:00 P.M.—Evening

ANNUAL BANQUET

FRIDAY, OCTOBER 24th

9:30 A.M.—Morning—Simultaneous Technical Sessions

PIPING AND PRESSURE VESSELS

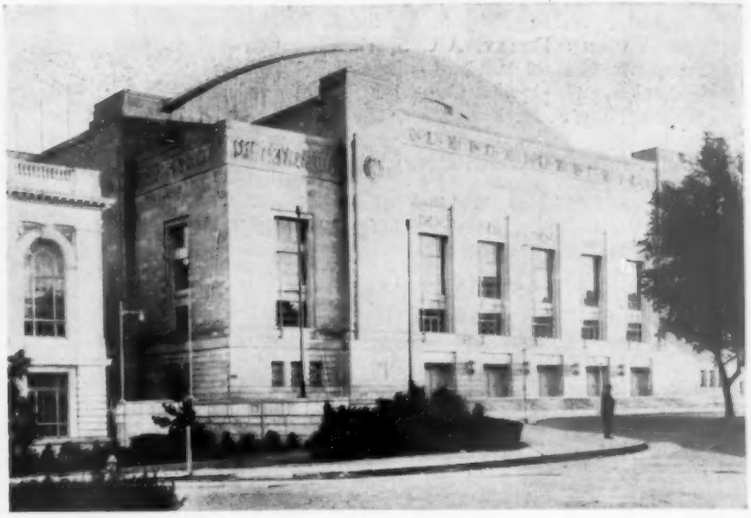
Co-Chairmen: D. H. COREY, Detroit Edison Company. R. B. CLEMENTS, The Linde Air Products Co.
"Flame Preheating and Stress-Relieving Arc-Welded High-Pressure Pipe Lines," by P. T. ONDERDONK and WERNER PETERSON, Consolidated Edison Company of New York.
"Welding Pressure Vessels, Tanks and Heat Exchangers," by H. B. SCHLOSSER, Edge Moor Iron Works.
"Radiographic Examination of Heavy Plate," by O. R. CARPENTER, Babcock and Wilcox Company.

WELDING OF HIGH-ALLOY STEELS

Co-Chairmen: R. D. THOMAS, Arcos Corporation. L. H CHRISTENSEN, Reid Avery Company.
"Hardness Measurements on Rolling Steel That Contained Welds," by J. T. PHILLIPS, Foster Wheeler Co.
"The Shotweld Process of Welding Stainless Steel," by DR. JOSEPH WINLOCK and J. J. MACKINNEY, E. G. Budd Manufacturing Company.

11:30 A.M.—Business Meeting

Chairman: G. F. JENKS, President, American Welding Society.
Annual Report of the President.
Election and Installation of 1941-42 Officers.
Board of Directors' Luncheon Meeting.



All-Out for the National Metal Exposition and Defense

"NEW Aid to National Defense Program" is the theme of the 1941 National Metal Congress and Exposition which will be held at the Philadelphia Public Auditorium the week of October 20th. The theme for the 23rd National Metal Congress and Exposition is especially appropriate by virtue of the gigantic defense program now under way. Here under one roof may be seen all the latest developments in welding, cutting, metallurgy, heat treating and fabricating which are so vital to our National Defense program, all depicted by means of ingenious displays, working models and demonstrations.

The doors to the Exposition will open at 12 noon, Monday, October 20th and will remain open every afternoon and evening until 10 o'clock with the exception of Thursday evening. On Thursday it will close at 6 P.M. to allow those attending the exposition to attend the annual banquets of the various societies in technical session in connection with the Metal Congress.

It is believed that the 1941 Congress and Exposition will be the largest in the 23 year history of this event. More than 105,000 square feet of exhibit space have been taken by exhibitors representing every branch of the metal and associated industries. This space will house the combined exhibits of more than 285 exhibitors.

In conjunction with the Congress there will be held 13 special defense meetings at which more than 100 specialists actively engaged in either industrial defense activities or government planning in the present emergency will present their thoughts on the National Defense Program. These sessions will be held during late morning, afternoon and evening the five days of the Metal Exposition.

Thus, gathered together at one time in one place, will be the outstanding authorities on manufacture, production and fabrication of metals who at these defense forum meetings will exchange and help smooth out such difficulties and problems as have arisen in the manufacture of national defense material.

The welding industry will be represented at the Metal Show by all types of welding equipment; arc, gas, and resistance as well as gas cutting equipment. Because of the importance of welding in our National Defense program, most of the exhibits will be of interest to all and especially to those in the welding fraternity.

As a special aid to the Show visitors, *The Welding Engineer* has listed on this and the following pages, those exhibits which are of particular interest to welding men.

EXHIBITORS

Abrasive Co., Philadelphia. (Booth G-39)
EXHIBITING: Grinding wheels and abrasive materials.
IN ATTENDANCE: R. S. TRIMBLE and W. E. REED, sales representatives; D. S. SAURMAN, advertising manager; and W. B. Ilko, sales manager.

Acme Electric Welder Co., Huntington Park, Calif. (Booth A-6) See Resistance Welders Mfrs. Assoc.

Advance Polishing Wheels, Inc., Chicago. (Booth G-34)

Allis-Chalmers Mfg. Co., Milwaukee. (Booth 86)

Aluminum Company of America, Pittsburgh. (Booth 52)
EXHIBITING: Aluminum Company of America and American Magnesium Corporation have a combined exhibit.
IN ATTENDANCE: F. L. GEMMER, in charge of booth and members of the research and technical staffs.

Alvey Ferguson Co., Cincinnati, Ohio. (Booth C-54)

American Brake Shoe & Foundry Co., Chicago Heights, Ill. (Booth D-23.) See American Manganese Steel Div.

American Brass Co., Waterbury, Conn. (Booth 278)
EXHIBITING (in operation): Two welding booths, one for arc welding, the other for oxy-acetylene, demonstrating the use of Anaconda 997 low fuming Tobin Bronze Everdur and other Anaconda rods.
IN ATTENDANCE: M. HAROLD DOWD, Exhibiting Manager.

American Chain & Cable Co., Bridgeport, Conn. (Booth A-27)

American Gas Association, New York. Combined Industrial Gas Exhibit.

American Gasifier Co., Wallingford, Conn. (Booth F-54)

American Institute of Mining and Metallurgical Engineers, New York. (Booth 293)

American Machine and Metals, Inc., East Moline, Ill. (Booth D-29) See Riehle Testing Machine Div.

American Machinist, New York. (Booth 3)

American Magnesium Corp. (Booth 52) See Aluminum Company of America.

American Manganese Steel Div. of American Brake Shoe & Fdy. Co., Chicago Heights, Ill. (Booth D-23)

EXHIBITING: Amsco Alloy Heat Resisting Castings and Amsco Reclamation and hard surfacing welding materials. Some welding demonstrations, using arc welding equipment.

IN ATTENDANCE: E. L. QUINN, manager, welding products div.; and D. B. RICE, assistant manager, welding production div.

American Metal Market, New York. (Booth A-19)

American Rolling Mill Co., Middletown, Ohio. (Booth F-31)

EXHIBITING (in operation): The part that Armco special metal sheets are playing in defense preparations will be spotlighted. A complete air-raid and munitions shelter will be the focal point of the 60-foot display.

American Society for Metals, Cleveland. (Booth 215)

American Welding Society, New York. (Booth H-43)

Ampco Metal, Inc., Milwaukee, Wis. (Booth F-50)

EXHIBITING: A welding booth will demonstrate Ampco Trode, a coated aluminum bronze welding rod, developing physical properties not now obtainable in ordinary bronze rod.

IN ATTENDANCE: R. W. UECKER, secretary-treasurer; J. D. ZAISER, assistant general manager; R. J. THOMPSON, district manager; and C. E. SWIFT, welding engineer.

Arcos Corp., Philadelphia. (Booth 12)

EXHIBITING (in operation): A special dipping machine will be featured for the manufacture of stainless electrodes by the dipped process.

IN ATTENDANCE: R. D. THOMAS, president; R. E. CARRIAT, secretary; H. N. EWERTZ, sales manager; R. W. OSTROM, welding technician; R. D. THOMAS, JR., metallurgical engineer; T. H. NELSON, salesman; B. B. ROSS, welding engineer; and E. C. SHOOK, salesman.

Automotive Industries, Philadelphia. (Booth A-54)

Babcock & Wilcox Co., New York. (Booth 27)

Bethlehem Steel Co., Bethlehem, Pa. (Booth D-6)

Black & Decker Mfg. Co., Towson, Md. (Booth 44)

Bridgeport Brass Co., Bridgeport, Conn. (Booth H-38)

EXHIBITING: A variety of samples made from various alloys such as Bridgeport Bronze Welding Rod and silicon bronzes by the trade name of Duronze Alloys.

IN ATTENDANCE: H. W. STEINKRAUS, Vice President; J. D. BURNHAM, Dist. Mgr. of Philadelphia Office; H. F. WAGEMAN, Asst. Dist. Mgr. of Philadelphia; A. R. ZENDER, Asst. Sales Manager of Bridgeport Office and PHILIP DAVIDSON, Advertising Manager.

Carborundum Co., Niagara Falls, N. Y. (Booth 236)

EXHIBITING: Abrasive and refractory products.

Carnegie-Illinois Steel Corp., Pittsburgh. (Booth, Stage.) See United States Steel Corp.

Carpenter Steel Co., Reading, Pa. (Booth 254)

Chase Brass & Copper Co., Inc., Waterbury, Conn. (Booth F-30)

EXHIBITING (in operation): Actual demonstration of the welding of bronze, copper, and steel, illustrating all types of difficult welds. Samples of welded material will be on display, together with many of the vital products which we are making for defense work.

IN ATTENDANCE: J. VREELAND; J. BABIN; A. MOREDOCK; F. GALLO; N. MITCHELL; W. EVANS; and D. K. CRAMPTON.

Chilton Co. (Booth A-54.) See Automotive Industries.

Colonial Alloys Co., Philadelphia. (Booth G-11)

Columbia Steel Co., San Francisco. (Booth, Stage.) See United States Steel Corp.

Continental Machines, Inc., Des Plaines, Ill. (Booth B-46)

Copperweld Steel Co., Warren, O. (Booth B-6)

Henry Disston & Sons, Inc., Philadelphia. (Booth F-58)

The Dow Chemical Co., Midland, Mich. (Booth G-61)

EXHIBITING: Dowmetal magnesium alloys.

IN ATTENDANCE: L. B. GRANT, manager; O. E. GRANT; G. W. DEKUIPER; L. H. STEWART; J. C. H. STEARNS; J. C. MATHES; and D. T. WELLMAN.

Eisler Engineering Co., Inc., Newark, N. J. (Booth A-50 and A-6.) See Resistance Welder Mfrs. Assoc.

EXHIBITING: Various types of spot, butt and arc welders.

IN ATTENDANCE: CHARLES EISLER, president; CHARLES EISLER, JR., chief engineer; and ALEX KLEIN, advertising manager.

Eutectic Welding Alloys, Inc., New York. (Booth A-11)

EXHIBITING (in operation): The new Castolin Eutectic Alloys for low temperature welding for all metals. These Alloys are particularly important for reclaiming at low temperature defective castings in cast iron, Monel, steel, nickel alloys, bronze and brass, aluminum, magnesium, as well as die castings. The Alloys bind at very low temperature without affecting the metal properties.

Also being shown in Castolin No. 16 for very low temperature brazing of tungsten carbide, for tipping tools.

IN ATTENDANCE: R. D. WASSERMAN.

Expert Welding Machine Co., Detroit. (Booth A-6) See Resistance Welder Mfrs. Assoc.

Federal Machine & Welder Co., Warren, O. (Booth A-6.) See Resistance Welder Mfrs. Assoc.

Firth-Sterling Steel Co., McKeesport, Pa. (Booth 98) See Resistance Welder Mfrs. Assoc.

Firth-Sterling Steel Co., McKeesport, Pa. (Booth 98)

Gardner Publications, Inc., Cincinnati. (Booth F-57)

General Electric Co., Schenectady, N. Y. (Booth 230)

The welding booth will be a giant model of a welding transformer in which will be demonstrated several types of welders. The G-E X-Ray Corp., will exhibit equipment used in X-raying metals.

IN ATTENDANCE: C. I. MACGUFFIE; B. C. TRACEY; C. L. IPSEN; and H. M. WEBBER.

General Electric X-Ray Corp., Chicago. (Booth 230.) See General Electric Co.

H & H Research Co., Detroit. (Booth 222)

Handy & Harman, New York. (Booth C-40)

EXHIBITING (in operation): A brazing station where low temperature silver alloy brazing joints of all types are being made, using Sil-Fos and Easy-Flo brazing alloys.

IN ATTENDANCE: F. T. VAN SYCKEL, Advertising Manager; J. C. POWERS, JOHN GUNTHER, HERMAN FOLGNER, A. W. SWIFT, and H. M. LUCAS.

Harnischfeger Corp., Milwaukee, Wis. (Booth 82)

EXHIBITING (in operation): The many advantages of P & H-Hansen arc welders, welding electrodes, and P & H electric hoists. The welders will be mounted against an indirectly light background of grotesque figures of welder operators, to dramatize the salient features of these welding units.

IN ATTENDANCE: L. M. STOUT, district manager, Philadelphia; C. W. DANIELS, district manager, New York; A. J. DREYER, district manager, Pittsburgh; E. T. SLACKFORD, advertising manager; B. PRATTE, sales engineer; and several others.

Hitchcock Publishing Co., Chicago. (Booth G-58)

Hobart Brothers Co., Troy, O. (Booth D-39)

EXHIBITING (in operation): Hobart "Simplified" arc welders—both gasoline and electric drive models. Models to be featured are the "Aircraft." "Special" and Hobart's "Streamliner" gasoline engine driven models.

IN ATTENDANCE: E. A. HOBART, president; W. H. HOBART, vice president; O. H. MENKE, production manager; W. J. CHAFFEE and E. K. BUTTERFIELD, welder sales.

Independent Pneumatic Tool Co., Chicago. (Booth C-21)

Industrial Publishing Co., Cleveland. (Booth A-26)

EXHIBITING: Description and illustrations of advance in the use of welding in fabrication, production, and repair.

IN ATTENDANCE: I. B. HEXTER, president; and L. P. AURBACH, vice president.

Industry & Welding. (Booth A-26.) See Industrial Publishing Co.

Ingersoll Steel & Disc Div., Borg-Warner Corp., New Castle, Ind. (Booth C-26)

International Nickel Co., New York. (Booth D-26)

The Iron Age, New York. (Booth 296)

Jessop Steel Co., Washington, Pa. (Booth 13)

Lincoln Electric Co., Cleveland. (Booth 40)

EXHIBITING (in operation): The exhibit will emphasize the importance of welding in National Defense, putting particular emphasis upon the arc welding of aircraft and ships. Actual demonstrations will show the arc welding of aircraft tubing and tubular parts, together with the welding of the various joints commonly used in ship construction. There will also be displayed for the first time at any national show important new developments in arc welding.

IN ATTENDANCE: A. F. DAVIS and C. M. TAYLOR, vice presidents; E. W. P. SMITH, consulting engineer; J. R. MORRILL, assistant to the vice president; G. R. JOHNSON and G. N. BULL, district managers of Philadelphia and New York; L. J. COGAN, JR., W. SIVYER, H. H. STAHL, W. D. WOOD, JR., and E. E. GOEHRINGER, welding engineers.

Machine Tool Blue Book. (Booth G-58.) See Hitchcock Publishing Co.

Machinery, New York. (Booth 23)

Macklin Co., Jackson, Mich. (Booth 274)

Magnaflux Corp., Chicago. (Booth A-30)

Mahr Manufacturing Co., Div. of Diamond Iron Works, Inc. Minneapolis, Minn. (Booth 7)

P. R. Mallory & Co., Inc., Indianapolis, Ind. Booth 202 and A-6.) See Resistance Welder Mfrs. Assoc.

EXHIBITING: A complete exhibit of parts made from Mallory nonferrous alloys, including all sizes and types of spot welding tips, seam welding wheels, flash, butt, and projection welding dies, water cooled holders, and many miscellaneous products, such as flat springs, backings, bushings and bearings.

IN ATTENDANCE: J. A. WEIGER, vice president, metallurgical div.; J. D. TEBBEN, sales manager, metallurgical div.; R. H. IMES, assistant sales manager, metallurgical div. and P. N. COOK, advertising department.

Maurath, Inc., Cleveland. (Booth D-31)

McGraw-Hill Publishing Co., New York. (Booth 3.) See American Machinist.

McKay Company, Pittsburgh. (Booth E-38)

Metal Progress, Cleveland. (Booth 215.) See American Society for Metals.

Metal & Thermit Corp., New York. (Booth F-26)

EXHIBITING: The complete Murex line, including seven different electrodes for arc welding of mild steel, as well as specially developed rods for welding various low-alloy, high-strength steels, for building up and hard surfacing worn parts and for a number of other applications will be displayed and demonstrated. In addition, the Thermit welding process for repair and fabrication of heavy parts will be featured and sample Thermit welds will be exhibited.

IN ATTENDANCE: J. B. TINNON, sales manager; C. D. YOUNG, Chicago district manager; H. T. THOMPSON, Pittsburgh district manager; C. D. COOPER, E. J. KNAPP, and JOHN PLASKIN, welding experts; and M. L. SMITH, advertising manager.

Metals & Alloys, New York. (Booth A-38)

National Time & Signal Corp., Detroit. (Booth B-63)

EXHIBITING: A visual portrayal of spot welding operations by means of colored light.

IN ATTENDANCE: R. S. FULTON, President.

Norton Co., Worcester, Mass. (Booth 290)

IN ATTENDANCE: W. R. MOORE, general sales manager; W. T. MONTAGUE, assistant vice president; G. A. PARK, Eastern sales manager.

Tinius Olsen Testing Machine Co., Philadelphia. (Booth 277)

EXHIBITING (in operation): Universal Testing Machine; New designed Impact Machine; Dynamic Balancing Machine; and Proving Ring and Instruments.

Page Steel & Wire Div., American Chain & Cable Co., Inc., Monessen, Pa. (Booth A-27)

Progressive Welder Co., Detroit. (Booth A-6.) See Resistance Welder Mfrs. Assoc.

Ransome Concrete Machinery Co., Dunellen, N. J. (Booth B-17)

EXHIBITING (in operation): 2500 lb. capacity motor operated and 8 ton motor operated welding positioner.

IN ATTENDANCE: W. MULLER, President; L. R. WILSON, Vice President; G. F. MONAGHAN, Advertising Manager; J. C. LUKAS, Sales Engineer; R. F. GARRETSON, Sales Dept.

Republic Steel Corp., Cleveland. (Booth D-36)

Resistance Welder Mfrs. Association, Philadelphia. (Booth A-6)

EXHIBITING: A lounge and general meeting place is provided where common discussion of all phases of resistance welding can be held. Engineers and representatives from all member companies will be on hand to discuss any problems or applications concerning resistance welding.

Revere Copper & Brass Co., New York. (Booth 248)

Riehle Testing Machine Division, American Machine and Metals, Inc., East Moline, Ill. (Booth D-29)

John A. Roebling's Sons Co., Trenton, N. J. (Booth H-16)

Joseph T. Ryerson & Son, Inc., Chicago (Booth G-17)

IN ATTENDANCE: G. VAN DYKE, manager, special steels dept.; J. W. QUEEN, JR.; H. B. BRIGGS; G. F. ROEDER; and C. C. BRAY.

Sciaky Corp., Chicago. (Booth 242)

S-M-S Corp., Detroit. (Booth A-6.) See Resistance Welder Mfrs. Assoc.

Steel, Cleveland. (Booth 70.) See Penton Publishing Co.

Stoody Co., Whittier, Calif. (Booth E-61)

EXHIBITING: Unprotected and hard-faced specimens. Printed case histories under each specimen will explain the advantages of protecting wearing surfaces with Stoody hard-facing alloys.

IN ATTENDANCE: J. R. SPENCE, general sales manager; GEORGE GRIFFIN, JR., assistant sales manager; G. F. STALEY, advertising manager; and K. B. TRAPP.

Summerill Tubing Co., Bridgeport, Pa. (Booth H-29)

Superior Tube Co., Norristown, Pa. (Booth H-46)

Swift Electric Welder Co., Detroit. (Booth A-6.) See Resistance Welder Mfrs. Assoc.

Taylor-Hall Welding Corp., Worcester, Mass. (Booth A-6.) See Resistance Welder Mfrs. Assoc.

Taylor-Winfield Corp., Warren, O. (Booth A-1 and A-6)

Tempil Corp., New York. (Booth 28)

Thomson-Gibb Electric Welding Co., Lynn, Mass. (Booth A-6.) See Resistance Welder Mfrs. Assoc.

Una Welding, Inc., Cleveland. (Booth 207)

EXHIBITING: Two portable type automatic heads, one mounted on a heavy duty carriage, self-propelling with complete cabinet mounting, together with the head. Small portable tractor, light weight for the shipbuilding industry, especially adapted for easy handling. A Una A.C. welding transformer with power factor correction built in.

United States Steel Corp., Pittsburgh. (Booth, Stage.)

EXHIBITING: The entire stage of the Commercial Museum Exhibit Hall in Philadelphia will be used by United States Steel Corp. in presenting their joint subsidiaries exhibit.

Cooperating in this joint exhibit will be American Bridge Co., American Steel & Wire Co., and Cyclone Fence Div., Carnegie-Illinois Steel Corp., Columbia Steel Co., National Tube Co., Scully Steel Products Co., and Tennessee Coal, Iron & Railroad Co., all subsidiaries of United States Steel Corp.

Wall-Colmonoy Corp., Detroit. (Booth B-55)

Welding Engineer Publishing Co., Chicago. (Booth H-53)

EXHIBITING: The Welding Engineer and The Welding Encyclopedia. There will also be a graphic display of wall charts which will depict the growth of the welding industry during recent years as well as display information of pertinent interest to those engaged in welding, and the many engineering problems encountered in this industry will be discussed.

IN ATTENDANCE: T. B. JEFFERSON, editor; D. R. WATSON, Midwest advertising representative; T. E. DEPEW, Eastern advertising representative; T. L. LAWLESS, LEE PLUME, and ROBERT GASTON, circulation representatives.

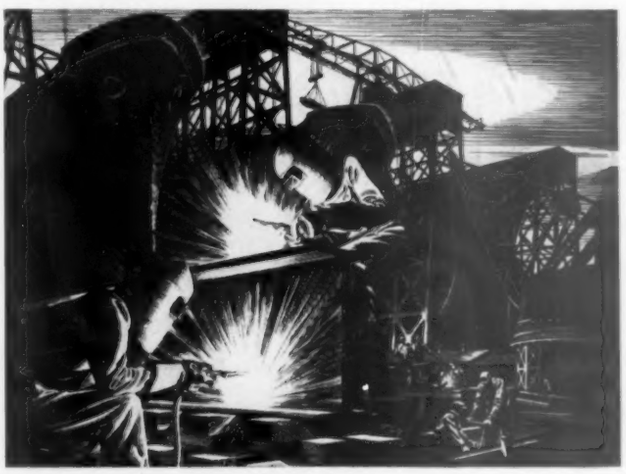
Welding Machines Mfg. Co., Detroit. (Booth A-6.) See Resistance Welder Mfrs. Assoc.

Welding Sales & Engineering Co., Detroit. (Booth A-6.) See Resistance WelderMfrs. Assoc.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. (Booth E-1)

EXHIBITING (in operation): Introducing for the first time a new electric welder which is in tune with the current defense theme. Resistance welding electric contractors (Weld-o-trol) and heat control will be not only displayed but an animation of the electrical circuit for these devices will clearly show how the weld is controlled. Phos-copper brazing will be demonstrated.

IN ATTENDANCE: L. M. GUMM; J. F. KELLY; W. R. BERNARDI; W. W. REDDIE; E. H. VEDDER; and J. H. GERMANY.



Carefully Controlled Electrode Comparison Tests are Profitable

By
WALTER J. BROOKING
Testing and Research Dept.
R. G. Le Tourneau, Inc.
Peoria, Ill.

Part 1—Simple testing equipment and simple tests make it profitable for the user of small quantities of electrodes to make comparative test. Procedures and test methods are outlined in this article.

No other item is of more fundamental importance in the arc welding process than the electrode itself. No other item is more deserving of an objective and thorough test before being adopted for any specific welding application than the electrode, yet many thousands of dollars of potential savings and profits are lost each year for want of the few simple observations required to make a practical test on the electrodes used on any arc welding application.

There are many broad, general principles of arc welding such as the materials used, the machines used, the design of the particular application, the factors of safety involved in the design, and the procedure of application of weld metal which allows any one of a large variety of electrodes to serve passably on a given application, but out of that large variety of electrodes there are one or two which will serve most economically for one or more reasons. The difference in actual cost of the finished job for the most economical electrode and some of the others less adaptable to that job is almost always large enough to make a significant difference in the cost of a job which involves only a small amount of electrodes.

Cost Variables

These differences in cost do not arise primarily from the original cost per pound of the electrode on the ordinary job (except perhaps in cases of alloy welding or hard-facing) but rather from the manner in which the characteristics of a given electrode fit the special requirements of the application. Every separate welding shop or factory, and each job in each shop is unique in some respects. Elements of design, materials, fixtures and position of joint when welded vary from one weld to another on all but the simplest jobs in any one shop. Elements such as type of welding machine, skill of operators, source of power and general methods of doing things vary widely from one welding establishment to another. The result of all of these variations is that an electrode which is best for one shop may not be best for another, and that one electrode which is best for some classes or types of weld within a given shop may be much more expensive than another for certain other applications in the same shop.

The importance of an intelligent choice of electrodes for a given job can hardly be over emphasized. In the first place, an electrode is essential raw material which, when deposited in the finished product, actually predetermines the strength of the unit since it is the material which joins together the parts of the unit.

This raw material usually costs less than 15c per lb. as purchased, but when it is actually in the deposited condition on a finished piece of equipment it costs from 75c to $2.50 a lb., depending upon the type of job in which it is used, and—of great importance,—how it lends itself to the application in which it is used. A very small difference in speed and efficiency of deposition alone may make as much as 15 or 20% difference in the "as deposited" cost per pound of weld metal. The inherent difference is often found to be a characteristic of the electrode as it applies to a given job.

Electrode Qualities

The first consideration naturally has to be an electrode which will yield joints which have as nearly the same physical properties as (or better than) the materials being joined together with the equipment and personnel of the shop in which it will be used.

Other considerations such as appearance of the welds made by average operators in the shop, cost of deposition, cost of cleaning and cost of finishing enter into the analysis.

In such an analysis of electrodes, a few very simple tests, if they are done accurately are much better than none. By the use of the simple tools for measuring and timing such as shown in Fig. 1, tools which can be found in even the smallest welding establishment, enough comparative information can be gathered on a set of electrode samples in a very short time to completely eliminate some electrodes for a given application, and to base an intelligent choice between the others

Fig. 1—Comparative Tests on Production Welds Are Best.

which can be used. (The testing equipment which should be used for the complete, and very practical testing for larger users of electrodes will be discussed later in this series of articles).

The Testing Problem

The testing and comparing of electrodes should be done by a man in the organization who knows the details of the welding problems and related processing in that shop. He does not necessarily have to know how to weld, but he does have to know how to interpret the things that can be observed with respect to a welded joint in its various stages of completion. He should observe someone else use the electrodes under consideration if possible, since it is very difficult for a man to check burn off rates accurately and actually burn the electrode himself. If he can weld and is doing welding regularly at the time, he should weld with the same electrodes to check for himself the "handling characteristics" of each.

Electrode Comparison

Electrode tests should be comparisons. Usually the shop is using some electrode for a certain application. A possible substitute electrode for that application should always be compared with the one in use. If the man who checks the electrodes is sure he can make the tests exactly the same every time and will keep exact records of each electrode tested, he can set up a procedure and run each new electrode singly, without testing the one in regular use every time. Thereby cut down on the time required for such tests. He should have the results of several tests which agree closely on his standard electrode before he feels sure that he can compare all new ones to it without checking them side by side.

The one who conducts the tests on electrodes should have in mind clearly: What the electrode is represented to be; what the proper operating conditions for that electrode should be; and should also have a clearly defined plan of testing which should not be subject to alteration from test to test. The ideal plan of approach to these tests is to have the electrodes which are to be tested together with complete general information as to type, etc. presented to the purchasing department; and they, in turn pass the samples and pertinent information on to the man in the plant who is to make the tests. In order to make the tests truly objective, the name of the electrodes should be omitted from the information given the man in the shop. He then should make the comparative tests and bring back an objective, factual report and recommendation to the purchasing department explaining exactly how the sample electrode compares with those used in the shop as standard. The purchasing department can then proceed to consider them in the light of how they serve the exact needs of the shop.

Any job involving even as small a quantity as 100 lbs. of electrodes deserves to have special consideration, since those hundred pounds of electrodes will represent an investment of from $40.00 to $150.00 in labor, power, electrodes and overhead before they are actually deposited as weld metal. Whether the cost is $40.00 or $150.00 depends to a certain degree on the characteristics of the electrode. A little study can often make a big difference as to just where between the $40.00 and $150.00 the actual cost will be.

Testing Procedure

The actual testing procedure depends upon the equipment available for making such tests and upon the amount of electrodes involved. Even the smallest welding electrode consumer has a watch, a measuring rule of some sort, and equipment for breaking or cutting through welds, even if the latter is only a jack or heavy hammer with which welded joints can be broken for examination. The major elements of cost can be checked by these 3 simple tools.

Rate of Burnoff

The watch (a stopwatch is better)

Fig. 2 — These simple measuring devices are all that are required to make comparative measurements on electrodes by which the user of only a few hundred pounds a year may realize important savings. (An ordinary pocket watch serves well if no stopwatch is available).

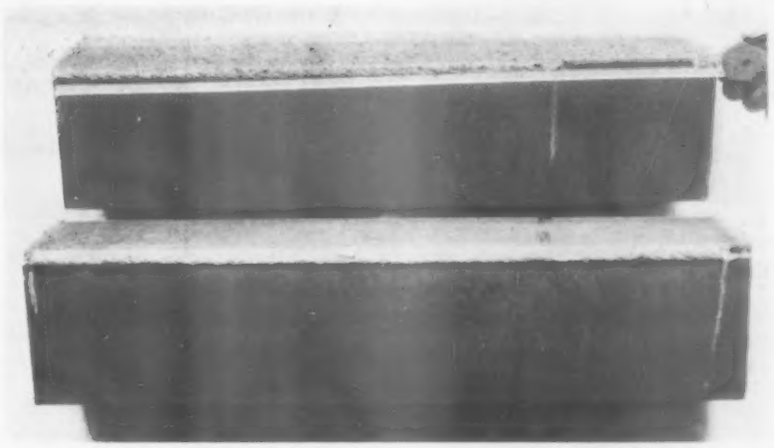


Fig. 3—These two beads show the difference in results obtained from different manufacturers' electrodes on the same type of joint.

can be used to time the rate of burnoff of the electrode. The actual number of seconds required to burn each of at least three electrodes of each kind being tested should be observed and recorded. The electrodes should all be burned down to the same length of butt—one and one-fourth inches for example, in order to make the burnoff time truly comparative. The burnoff rate per pound can then be determined by finding the number of electrodes in a pound of new electrodes. Each kind of electrode should be burned off at the machine setting at which it operates best on the particular weld being made for the test. All electrodes tested should deposit the same kind of weld and the weld should be typical of the welds made in the shop. This gives them all the same conditions, and allows the individual differences in electrodes to be measured. Careful timing and recording and careful measurement of electrodes and butt lengths must be made because the most important differences are usually a matter of only a few seconds or a fraction of an inch in measurements. If these measurements are not accurate, the test may lead to the wrong conclusion, and defeat the purpose of the testing program.

Lineal Inches of Weld

The lineal inches of weld per pound of electrode can be checked with any measuring rule which is graduated to one-eighth of an inch. The number of inches of complete and satisfactory weld per pound of electrode is a measurement which should be made on those welds from which the burnoff rate was recorded. It is not unusual to find considerable difference in the number of inches of completed weld per electrode between different kinds of electrodes. There are two primary reasons for this: (1) The electrode may deposit a weld which has a tendency to build up a convex deposit, depositing more metal per inch than another having more fluid metal or one fusing more of the parent metal into the joint (an all purpose type electrode as compared with a strictly downhand electrode are examples of the extremes in this type of difference) (2) A greater percentage of some electrodes — both core wire and coating—are actually deposited in the weld than are some other electrodes, because of differences in the tendency to spatter, or because they differ in the percentage of coating which is actually reduced to weld metal.

Slag Removal Time

Slag removal time is an item of some importance, especially in the deposition of large, multipass welds which are relatively short; or in welding deep, narrow groove welds. The comparative length of time required for slag removal under normal conditions for the shop for which the tests are made should be checked with a stopwatch or hand watch in electrode tests, and calculated as minutes per pound of electrodes burned.

Simple Test Results

These three items, burnoff rate per pound, lineal inches per pound, and slag removal time per pound can all be determined by the use of only a watch and a rule, assuming that the test was started with a known number of pounds of sample so the number of electrodes per pound could be determined. This simple procedure makes it possible to test at least two samples of electrodes—for example, a new electrode and the regular one used in the shop in the course of only two or three hours. The comparative rates of burnoff per pound of electrode and the comparative lineal inches of complete weld per pound of electrodes are usually the most important. From these two can be calculated the comparative length of time it takes to deposit a given number of inches of completed weld with a given electrode, and the cost of the electrodes required to deposit that length of weld. From the deposition time the cost of the labor involved can be calculated, (it must be remembered

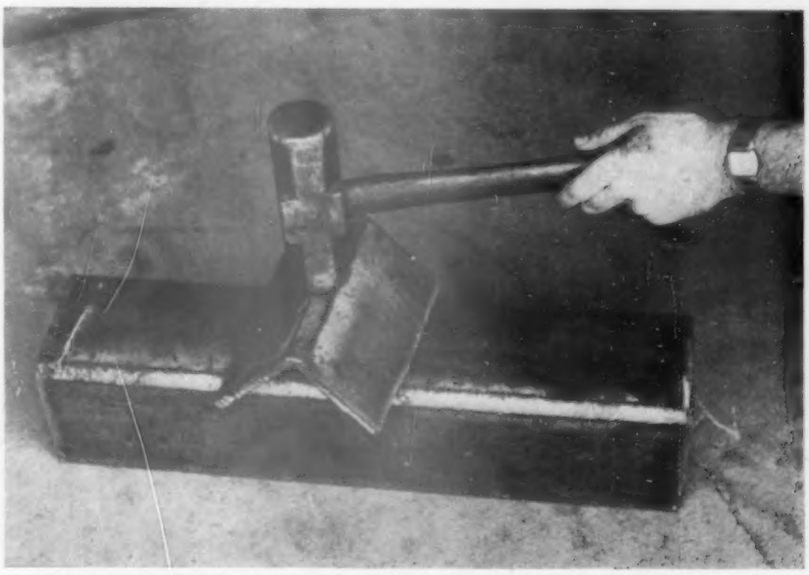


Fig. 4—A heavy press or expensive testing machine is not needed to see the inside of a weld. A heavy hammer will serve as well in most cases.

that only actual arc burning time was obtained in the deposition test, but the comparative burnoff time for different electrodes is the important item so far as the electrode differences are concerned). The labor and electrode cost as determined above gives a figure which is comparable except for the cost of power consumed in the burning off process. If there is a marked difference in the figures for different electrodes, the electrode with the lowest figure should be the most economical of the two — everything else being comparable — since the comparative ratio of electric power cost to labor plus electrode cost is quite small.

An example of such a comparative cost is shown in Table I.

Table I—Comparative Electrode Cost.

	Electrode A	Electrode B
Number of electrodes/lb.	4.5	4.4
Average arc time per electrode	89.5 seconds	90.4 seconds
Inch of a standard weld deposited per electrode	19.2 inches	21.9 inches
Total arc time/lb.	(4.5x89.5) = 402.75 sec.	(4.4x90.4) = 397.7 sec.
Total inches of standard weld/lb.	(19.2x4.5) = 85.4"	(21.9x4.4) = 96.4"
Cost of electrode/lb.	$0.13/lb.	$0.13/lb.
Cost of labor for burnoff/lb. at $1.00/lb.	$\left(\frac{402.75}{60x60}\right) \times \$1.00 = \$0.112$/lb.	$\left(\frac{397.7}{60x60}\right) \times \$1.00 = \$0.110$/lb.
Electrode plus labor cost per/lb. of purchased electrode	$0.242/lb.	$0.240/lb.
Cost per inch of weld for electrode and labor	$\frac{\$0.242}{85.4} = \$.00283$/inch	$\frac{\$0.240}{96.4} = \$0.00249$/inch

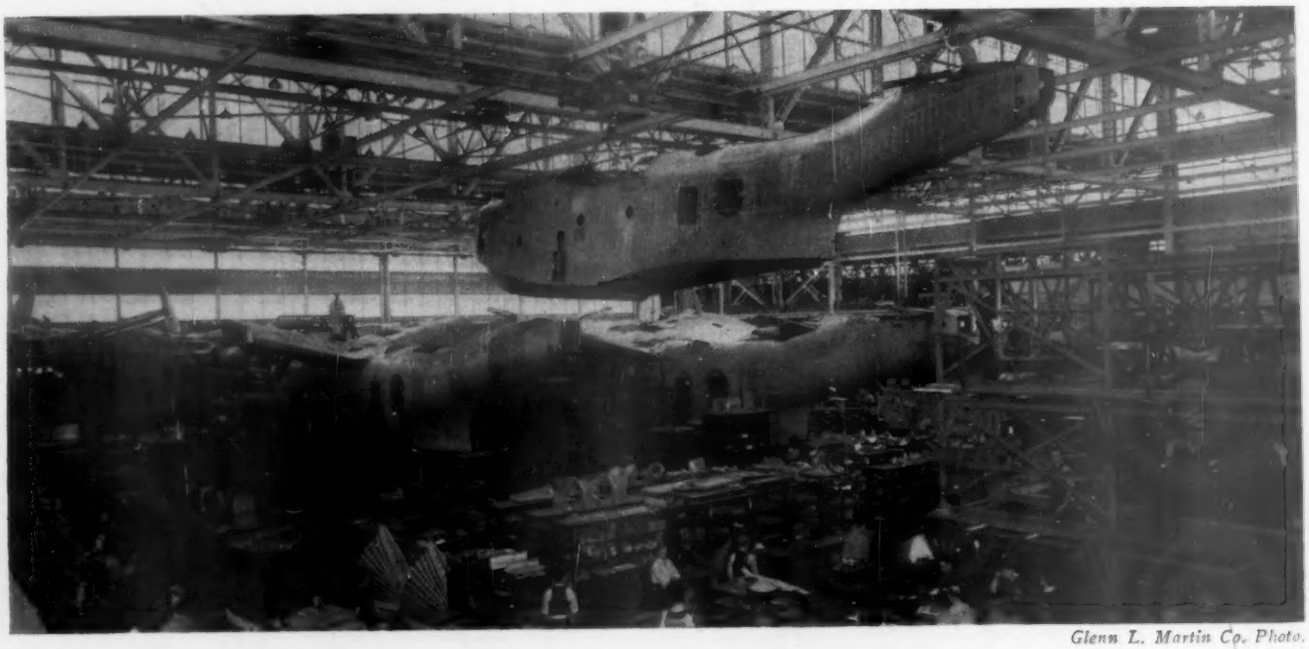
Percentage difference in cost per inch of weld in favor of electrode B = 13.7%

A difference of 13.7% in the actual cost of welds deposited by one electrode as compared to another is a considerable difference! Many industries operate on a net profit of less than 13.7%. Where as important and proportionally large an item of expense as welding electrodes is found to vary as much as 13.7% in cost, by the use of two different electrodes which both cost the same per pound, the value of such simple time and measurement tests as this is obvious. The difference only on 100 lbs. of electrodes used between the two electrodes described above amounts to $3.28. For example electrode B would deposit 9,640 in. of weld such as was measured in the test at a cost of $0.00249 per in., or $24.00 for electrode and actual burning time. If electrode A were used to deposit 9,640 in. of such a weld it would cost $0.00283 per in., or $27.28. These are actually measurable differences between the electrodes on a certain application, no overhead has been calculated in the cost. This figure does not represent the cost of deposited metal per pound, but merely represents the most significant differences between the cost of applying one electrode to the same job.

It is significant to note in the above case that if the burnoff rate alone had been considered as the basis of choice and no measurement of inches of welding nor number of electrodes per pound had been considered, electrode A—the least efficient would have been chosen. The measurements show however that it actually costs slightly more for labor to burnoff one pound of electrode A than it did of electrode B. Burnoff rate, number of electrodes per pound, and inches of weld deposited by a pound of electrodes are all important parts of the cost picture, and one cannot be considered separate from the other without giving an incomplete, and probably wrong results. Even the simplest tests must be completed to get truly useful data.

The second part of this series will be published in the November *The Welding Engineer*. It will discuss further the importance of comparative tests in the selection of electrodes.

(To be continued)



Glenn L. Martin Co. Photo.

The Hull of a 20 ton Navy PBM-1 patrol bomber is lifted from the hull fixture at the Glenn L. Martin Plant.

Heat Controls in Welding

By
A. F. DENHAM

The many types of metal and methods of welding makes accurate control of heat in resistance welding extremely important. Some methods of heat control are described.

THE requirements for certain resistance welding operation are frequently such as to demand closer regulation of current than it is possible to obtain through the conventional step regulation provided with an auto-transformer. When such regulation is desired, it can be provided in the average welding installation in an extremely simple manner by the addition of an electronic heat control. As the term "electronic" implies, this type of heat control requires that a tube-type of contactor be used. When such a heat control is provided, there is no further need of the auto-transformer and it may be omitted. In this type of installation, the function of the electronic heat control is to provide a means of eliminating or "chopping out" portions of the heat wave, thus controlling the amount of current actually used in making the weld.

There are many kinds of electronic controls on the market. However, the discussion in this article will be limited to a particular type which features a simple means of heat adjustment through the use of a graduated control dial. This type of electronic heat control is capable of providing indefinite variations in adjustments of current value ranging—for a supply voltage of 440 or 550—from 20 to 100% of available power. In the case of the 220 voltage supply, the low limit is raised to 40%.

This unit is connected into the welding circuit between the timer (regardless of make) and the contactor as is shown in the schematic circuit layout pictured in Fig. 1. It should be noted that the auto-transformer has been eliminated from the circuit in which the heat control has been installed.

Where several welding transformers and one timer are used in the operation of more than one piece of welding equipment, it is recommended a dual or triple unit heat control be provided. The advantage of a multiple unit heat control is that one of the control dials may be set at the desired adjustment for a particular welding machine and left at that setting during the entire welding operation.

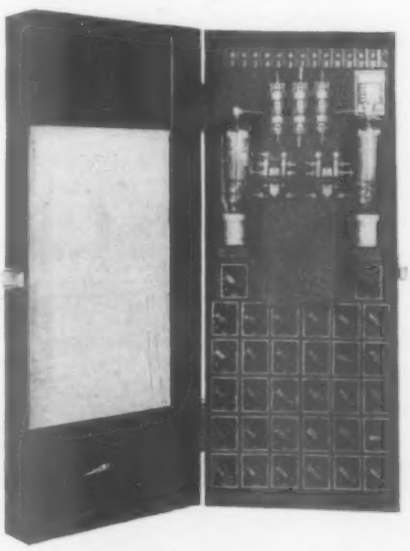


Fig. 1—This panel can control the heat at sixty-four weld points.

Multiple Spot Welding

An extremely important use of heat controls occurs in connection with the use of multiple point welding machines. In these machines the automatic sequence of a series of welds is started by the closing of the pilot switch. Experience has shown, however, that the effect of induction, non-uniform resistance and other electrical disturbances result in unequal current values at the various welding points where equal values are desired, resulting in non-uniform welds. Likewise, difficulties have been experienced where different values of current are desired at different points in the welding sequence. An example of this may be found when the sequence requires the welding of two thicknesses of metal at one place, three thicknesses at another, and possibly two different thicknesses in still another location.

The answer to the multiplicity of current control problems arising from such conditions is a control which will permit the accurate current adjustment to the exact values desired for each type of welding operation. One solution to a situation of this type is found in the heat control panel pictured in Fig. 1. This control is

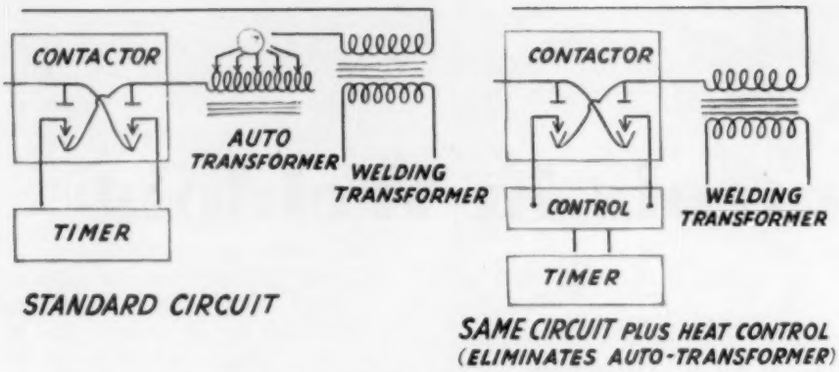


Fig. 2—The addition of a heat control eliminates the need for an auto-transformer.

provided with as many dials as there are welding operations to be performed in one complete welding cycle. Each dial is set, by trial, to obtain the best operating conditions for each separate welding operation. The simplicity of such control unit is disclosed by the fact that only two wires are required to connect it into the welding control circuit.

By setting a dial for each operation, with each dial independent of all others, it is possible to eliminate all effects of induction, resistance, and other variations in current values at each of the various welding points. Despite these complicated operating restrictions the control becomes entirely automatic in operation. For example, the setting of dial No. 1 will always correspond to that required for the first weld to be made. Dial No. 2 is set for the second weld and so on through the entire welding sequence. If two spot welds are made in a series at one time, the first dial, of course, controls the current for the first pair, the second dial for the second pair of welds, etc.

When the weld cycle has been completed, the heat control is reset automatically to the starting point, since its operation is controlled by a sequence timer. Fig. 3 shows the relation of this type of heat control to the welding circuit.

Pulsation Welding

Pulsation welding which is now becoming extremely popular also demands accurate heat controls. This type of welding is now being used extensively for the welding of thicker steel sheets, as well as material such as stainless steel, aluminum, and other materials in which the welding current is interrupted, or broken, into "shots." In such an application the first "shot" may be at a minimum welding current value. The next pulsation would then be at somewhat greater current value, the third still larger, each increment continuing to increase until the weld is completed. By pulsation welding it is possible to control the rate of temperature rise in the material being welded so as to eliminate excessive changes in grain structure adjacent to the weld and to control heat flow from the weld itself.

The heat control used in pulsation welding may be similar to that for multiple point welding operations. Here again the panel may carry any number of control dials, the number being determined by the number pulsations desired. As in the case of multiple point welding, the first dial would control the current flow for the first pulsations, the second dial for the second pulsations, and so on until the desired number of pulsations are obtained. With such a control, the current value for each individual pulsation is set to give the current value desired between the minimum current and the full current.

When the material being welded has considerable scale, rust, etc., the initial current is generally set at a minimum value (20% when using 440 volts) for the first pulsation. When this is done, a good contact is generally established without the shower of sparks which usually would result if full current were applied.

In discussing the types of heat control, there has been developed a control which will perform the same functions as the multiple control heat unit but requires only three dials control for any number of pulsations per weld. In this control, one dial controls the amount of initial current, the second controls the final current, while a third dial controls the current rise during the weld. Actually, the third dial serves to control the time required to raise from its initial setting to the value corresponding to the final current setting. The design is such that this overall time may be varied from the minimum of 3 cycles to a maximum of 120 cycles or a range of 1/20 of a second to 2 seconds when using 60 cycle current. The setting of the third dial may be made to correspond with any proportion of the total weld time on the sequence timer.

Conclusions

Thus the heat control may be set to provide for any of the following conditions:

(1) Pulsations start at a minimum current value and rise to maximum current value for the last pulsation.

(2) Pulsations start at minimum current value and rise to maximum at any pulsation desired, continuing at maximum to the end of weld time.

(3) Pulsations start at maximum and continue at maximum value throughout the weld time.

The use of this latter type of heat control is not confined of course to pulsation welding. It may be used for a repeated single weld where it is desired to increase current value gradually during actual welding.

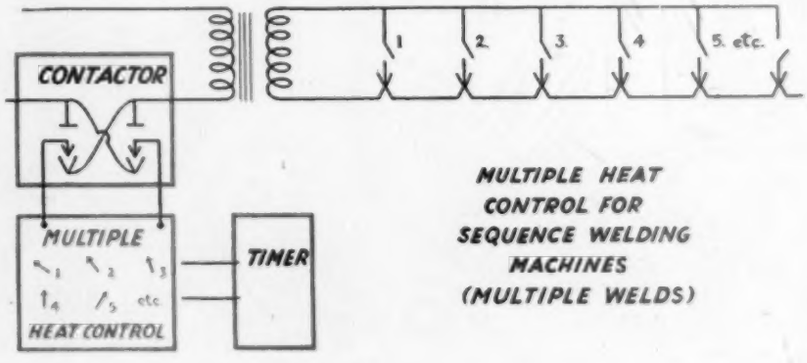


Fig. 3—A multiple head control in the welding circuit.

The Cutting-Flame of Defense

JAMES T. BARTON
Consultant

DEFENSE demands increased production. Headlines like this and others in similar tone are continually shouting at industry. Not that industry is particularly at fault but because people like to shout.

When it became necessary to step up production to meet the needs of our national defense program, naturally industry would appear slow to respond when overnight it is expected to triple its production.

Such production increases have led to a shortage of tools or facilities for doing such a job. One of the places this has been found to be true is in those industries whose production schedules necessitate the use of forging. This is especially true in the case of heavy forging; for, because of their size, they can be produced only under heavy forging hammers. Inasmuch as a definite amount of working under the hammer is necessary to produce each forged part, production is limited. Production can be increased only by the use of more forging hammers.

The present difficulties that are being experienced in obtaining machine tools, of which, forging hammers are one type, practically eliminates the addition of equipment as a solution to the problem of increased production. Another possibility and one which is more feasible under the circumstances, is flame cutting.

It has been found that by the judicious use of flame cutting satisfactory substitutes for forgings may be obtained from heavy slabs and billets. The piece which is obtained by flame shaping a billet is as sound and equally as satisfactory as forging yet it can be produced in much less time.

Flame Cutting Simplicity

In many instances the replacement of a forging with a flame cut counterpart is comparatively simple and involves only skill in the flame cutting of metal. There are times, however, when such an operation calls for not only skill but careful forethought. An example of such a job is shown in Fig. 1. In this case we have an intricate reverse lever crank arm which was shaped, by oxy-acetylene machine cutting, from a 12 in. thick slab of steel.

To flame shape such a piece as this crank arm from a billet or slab requires considerable thought before such a job is undertaken. The sequence of the cutting operations in the forming of this piece are shown in Fig. 2. It will be noted that by careful layout it is entirely possible to flame shape this relatively complicated shaped crank arm in three set-ups. In each case a cut was made on a side and then the piece was turned a quarter revolution one way or another and a second and third cut made.

In the making of such a heavy lever arm it is possible to flame shape many of them in only a portion of the time that would be required to forge one. The production cost would be reduced similarly, so that several pieces could be made for the previous cost of one piece.

Flame shaping operations are relieving some of the congestion in the forge, foundry and machine shops. The result is faster and less costly production.

A Forging Substitute

The steel mills are especially finding it advantageous to use flame cutting instead of forgings in these days of defense production. The demand that has been placed upon the various mills for increased rolling capacity means continuous operation with little time for overhauls and shutdowns.

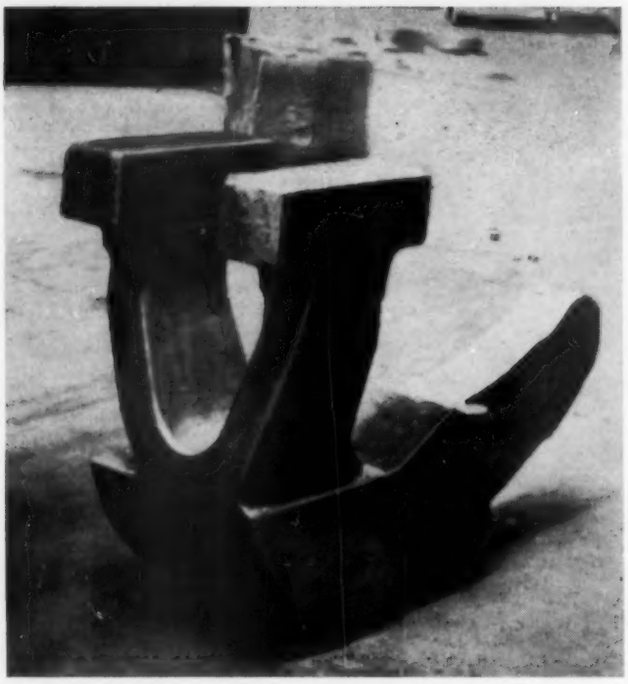


Fig. 1 — This intricate reverse lever crank arm was readily shaped from a 12 in. thick slab of steel by oxy-acetylene machine-cutting.

Such operating conditions naturally impose severe service problems and as a consequence there are equipment failures during operation. When such a breakdown occurs there is little time to wait for a new casting or forging. Production schedules are too rigid to make it possible to shut down and wait for replacement parts to be produced by the usual manufacturing methods. Realizing that much time can be saved the plant engineer has turned to flame cutting as a substitute for forgings for the quick production of heavy steel mill parts. An example of this is shown in Fig. 3 in which we see an 8 in. shaft which has been rough machined and now must have splines machined on the ends to engage with the rolling mill drive clutch. The machining of splines about 3 in. wide and 12 in. long is a long and tedious milling machine proposition, to say nothing of the difficulties which are encountered in placing such a piece in position for such a milling machine operation. Such a job can be accomplished by flame gouging in the time that normally would be consumed in setting it up in a milling machine. Furthermore, it can be done out in the mill where the shaft is ultimately to be placed in service.

Machining Eliminated

In Fig. 3 there is also pictured a welding operator engaged in the operation of flame gouging, one of the four splines of this rolling mill drive shaft. The entire job was completed in little over two hours, since it required about 30 minutes to flame gouge each spline. The only machining operation now required to finish the shaft so that it may be placed in service is a light grinding operation which removes the rough kerf and slag formation along the cut groove.

There may also be seen in Fig. 3 a drive clutch which has been entirely flame cut from a heavy rolled plate section.

Heavy Shape Cutting

Another example of how the steel mills are using flame cutting is seen in Fig. 5 which pictures a 3-ton pitman. This huge piece was readily shape cut using a template to guide the cutting machine tracing wheel. This piece was flame cut so true that again it was only necessary to use a hand grinding machine to do the final finishing operation. It can readily be seen that the forging and machining of such a piece would require many hours in the forge shop followed by many additional hours in the machine shop. Not only did the flame cutting in this case save considerable time but also much material. Referring again to Fig. 5, it will be noted that from the template that these two pieces forming the pitman were arranged so that they were cut from a much smaller slab of steel than would normally be required if the pieces were to be forged and subsequently machined.

On another occasion a cast drive pinion on a bending roll failed. This 10 tooth pinion was 11¾ in. in pitch diameter with a 4 in. face. When

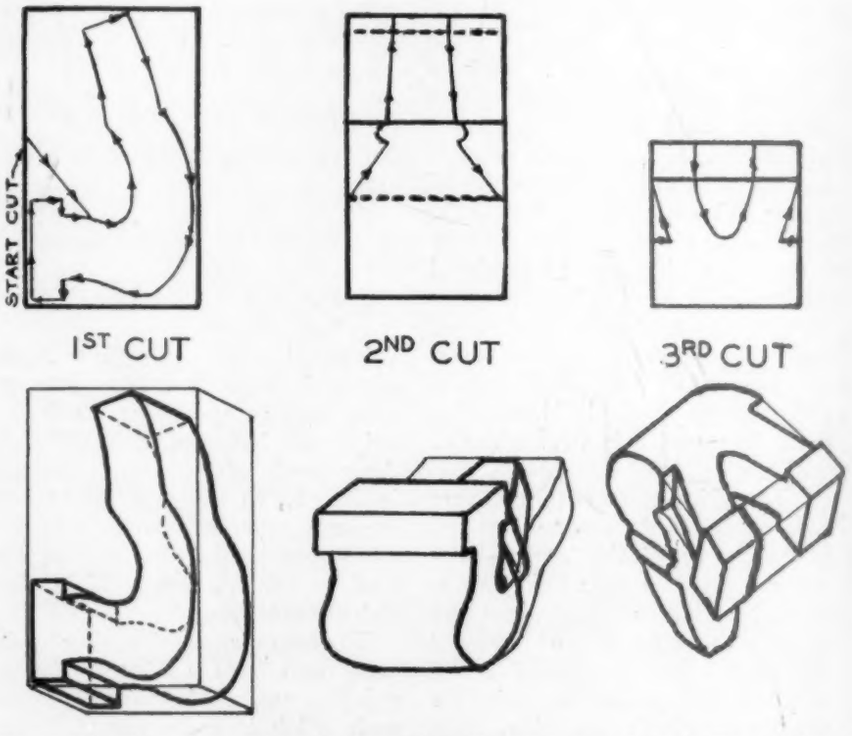


Fig. 2—The three cuts required to flame shape the crank arm shown in Fig. 1. Arrows indicate direction of cuts.

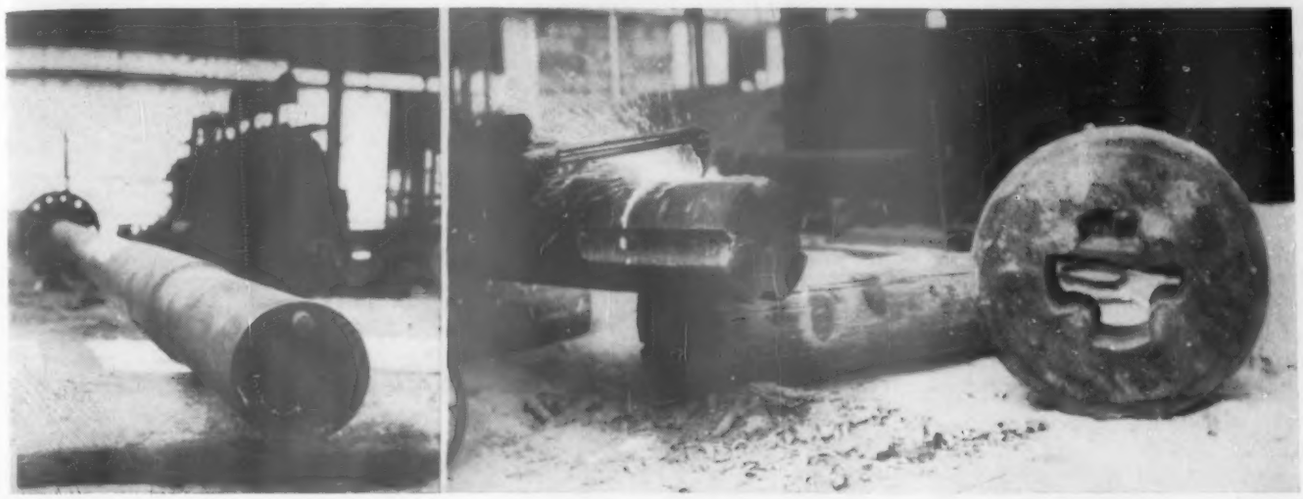


Fig. 3—Flame gouging simplifies the task of shaping the end of an 8 in. shaft (left) to fit into a rolling-mill drive clutch. (Right) The nearly finished shaft and a flame cut clutch.

the plant engineer placed a call for a replacement, it was found that because of existing foundry and shop conditions it would be impossible to obtain a cast gear in less than two weeks. Meanwhile a badly needed machine in a busy plant would be idle. To overcome such a situation it was decided to replace the gear with a steel gear flame cut. A paper template was made of the gear's profile and placed on a modern flame cutting machine. The profile was then cut from a 3 in. steel plate, the face width being reduced because of the stronger material, and in less than two hours this pinion (Fig. 4)

Fig. 4—This steel gear was flame cut from 3 in. steel plate.

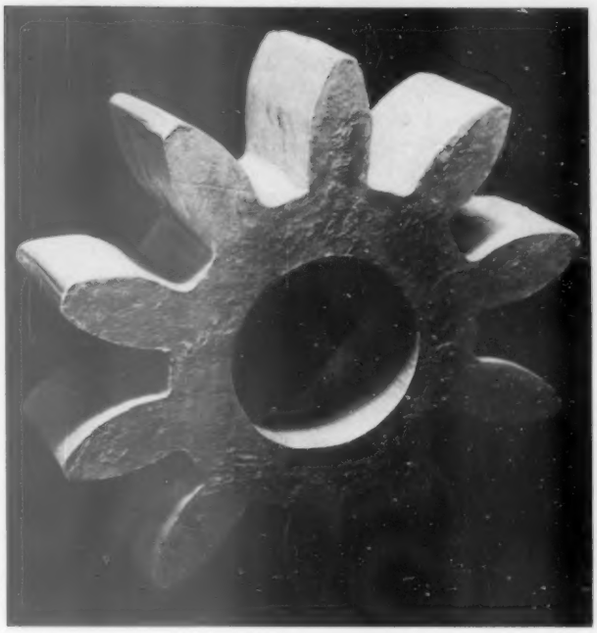


Fig. 5—With the easily made templet guiding the cutting machines tracing wheel, this 3-ton pitman was readily shape-cut by the oxy-acetylene process. Note how the pieces were nested, on the template, to conserve material.

was on the machine and the bending roll was back in service.

The remarkable part about the flame shaping of gears and pinions is the fact that in many cases the teeth require no further machining. When the machine cutting operation is completed the teeth are nearly as perfect as machined teeth. In any case the tooth form is sufficiently true, on the larger pitch sizes, to permit installation without further machining.

Production Flame Cutting

The steel mills, with their maintenance problems, are not the only places in which flame cutting is now replacing forging and other machining operations. Manufacturers of various types of equipment are finding that flame cutting can be advantageously used in their production operations and when it is used their

machine tools are freed for more urgently needed production problems.

Shape cutting of small machine parts is constantly being practiced by many manufacturers to relieve congestion in their forge shops and foundry but of equal importance is the work of flame cutting to relieve the machine shop. An example of the manner in which flame cutting is employed for new production is found in the plant of a manufacturer of linoleum cutting knives. These knives, which were formed previously in a milling machine, are now flame cut six at a time, Fig. 6. This is accomplished by stack cutting, a method by which six plates are stacked, clamped tightly together and then cut, using a flame cutting machine. The true finish, smoothness and high quality of this method of cutting may be observed in Fig. 7. Here again the quality of the cutting is sufficiently true and keen enough to eliminate the necessity of further machining operations.

Fig. 6—Linoleum cutting knives are shape-cut six at a time by means of the stack-cutting of piled plates with an oxy-acetylene cutting machine.

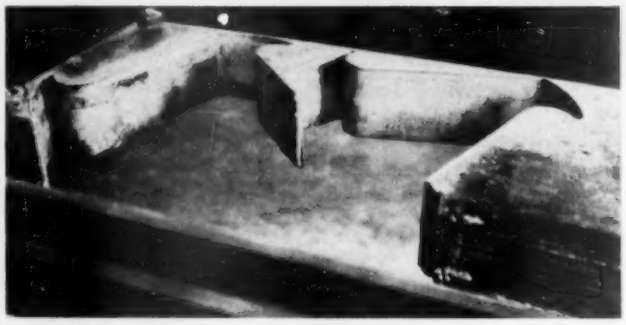


Fig. 7—A view of the scrap shows the high quality of the cut edges.

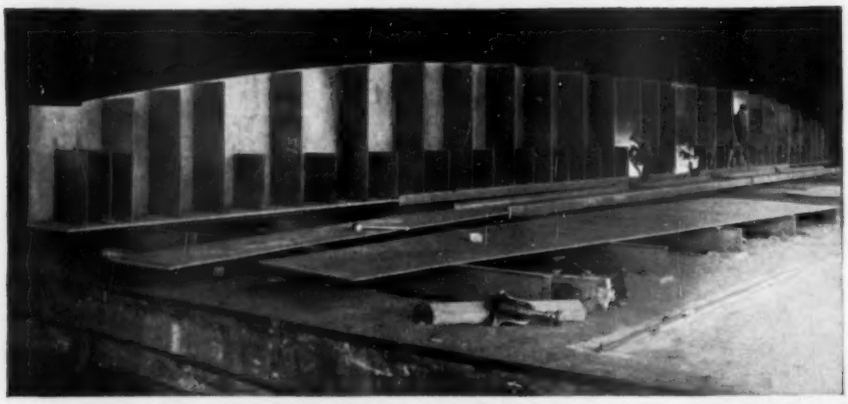


Fig. 8—Flame cutting quickly shaped the many pieces needed for this crane beam.

Machinery frames and heavy structural parts are also being fabricated readily by welding with the assistance of flame cutting. In this type of fabrication it is not unusual to flame cut material for all-welded assembly which varies in thickness from ½ in. to 4 in. An example of the application of flame cutting for subsequent fabrication by welding is shown in Fig. 8. In this illustration there is pictured a partially completed crane girder showing how many flame cut pieces are welded together to form what will be the world's largest all-welded crane girder.

Plates ranging in thickness from $\frac{7}{16}$ in. to 1¼ in. are being welded into position. This girder when completed will weigh 45 tons, have a span of 105′-0″ and be over 8′-0″ high at middle. As a result steel is joined by welding to form a huge girder which will be stronger and more rigid for its weight than is possible by any other method of construction.

These, of course, are only a few examples of the important roles the manual and machine cutting torch are playing. There are many flame shaping applications which because of their military importance cannot be discussed at the present time.

The adaptation of flame shape cutting to aid in fulfilling industry's needs for forged parts is just another illustration of American ingenuity. It is this initiative which has speeded forward our defense production program. The same initiative which has discovered ways for the cutting flame to relieve congestion in our forge and machine shops for more essential production.

The illustrations are credited as follows: Figs. 1, 3, 5, 6 and 7, The Linde Air Products Co.; Fig. 2, the Author, Fig. 4, By-Products Steel Corp., and Fig. 8, Cleveland Crane Engineering Co.

Photo-Caterpillar Tractor Co.

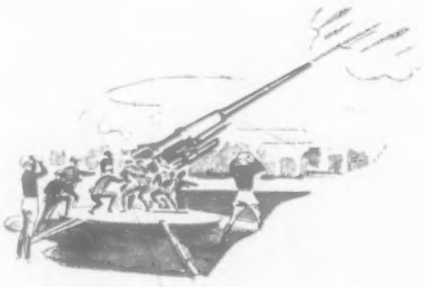
A diesel-powered welder maintains a diesel-powered ditcher.

Weldable Alloy Materials

Ferrous and Non-Ferrous

(A Survey)

T. B. JEFFERSON
Editor



Substitutes are in order! It is so that you, the fabricator of welded products, might be able to substitute materials having similar chemical, mechanical and welding properties for those materials you are unable to obtain, that this survey was made.

Weldable Alloy Materials

In this eighteen page tabulation 317 weldable alloys, ferrous and non-ferrous are listed. There is given information as to their chemical and mechanical properties as well as their welding qualities by the arc, gas and resistance welding processes.

THE constant demand for stronger and lighter fabrication has lead to the desire to weld alloy materials. Alloys, both ferrous and non-ferrous, however, frequently demand a special welding technique because of the "tricky" reactions, when subjected to heat, of the various elements which have been combined to produce the alloy in question. Naturally, under such conditions, there is a tendency by a fabricator to question the advisability of welding any alloy material which he has not previously welded or which he knows is weldable.

In these days of substitutes, it is often impossible to obtain the "old standby" alloy and instead of a new one, "substitute" alloy comes your way. Well! Can "substiute" alloy be welded? Who makes it? What are its normal chemical properties? Mechanical properties? In what other shapes can it be obtained? So that the readers of *The Welding Engineer* might have all this information at his fingertips, a survey was made and the results are published on the following pages.

In this survey questionnaires were sent to every known producer of alloy material in the United States. So that the final results would be of greatest value to those in the welding industry, only those alloy producers making sheets and plates were considered eligible for listing. Such limitation naturally prevented the listing of many alloys but it is felt that those in the welding industry are primarily interested in welding alloy sheets and plates. Of course, if a manufacturer produces alloys in sheets and plates and also in other forms, practically all of the available forms have been listed in the tabular results of this survey.

The chemical composition of the various alloys listed must not be considered as exact. They are the nominal or approximate percentages and may vary within the practical limits which will not materially affect the other qualities of the material. It should be noted that in many alloys, particularly the ferrous alloys, that phosphorous and sulphur is not necessarily considered as an impurity. These two elements are frequently added to the alloy to improve its machining qualities, etc., thus accounting for their presence in seemingly high percentages in some alloys.

It should be noted that many of the various types of stainless steels are produced by most of the major steel producing companies. While several of the copper alloys are common to the three listed producers of these materials.

The various clad alloy materials have also been included in this survey. The stainless clads are listed among the weldable ferrous alloys and the nickel and related clads are in the non-ferrous listings. In either case, the chemical composition, mechanical and welding properties which are given refer only to the clad material. Inasmuch as these clads are usually bonded to a mild steel plate, little difficulty is encountered in welding the mild steel plate so naturally those references made to welding properties are those of the clad alloys.

The mechanical properties of welded strength, tensile strength and ductility are also only the nominal figures. In most cases it can be assumed that the figures given are the minimum expected results. These mechanical properties frequently range between wide limit because of various processing operations, such as, heat treatment, hot or cold working, annealing, etc.

Under the heading of Welding Qualities it will be noted that only the arc, gas and resistance process of welding have been considered since these three processes are the only fusion welding processes practical for joining sheets and plates. Unless it is otherwise noted, it should be considered, in these tabulations, that arc welding refers only to the metallic arc welding process. Many of the alloy materials listed are also weldable by other arc welding process, e.g., Atomic hydrogen, carbon, or submerged melt (Unionmelt) processes; but since the use of these processes and information regarding their results when welding alloys are limited, they were not considered in this survey.

In the case of many of the alloy materials available, they are weldable only if certain conditions are met. Most of these conditions are summarized briefly in the footnotes accompanying the tabular listings. If any doubt exists after having noted the requirements which, as outlined in the footnotes, must be fulfilled to successfully weld a given alloy, it is recommended that the producer of the material be consulted.

WELDABLE ALLOY MATERIALS—FERROUS

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
1	AISI 4608	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .040 max.; C. .12 max.; Mn. .30-.50; Si. .15-.30; Ni. 1.40-1.75; Mo. .15-.25.	y	y	y	S, CR.	A	D	D	1
2	AISI A-2330	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .040 max.; C .28-.33; Mn. .60-.80; Si. .15-.30; Ni. 3.25-3.75.	z	z	z	S, P, B.	B[15]	D	D	2
3	AISI A-4142	U.S. Steel Corp., Pittsburgh, Pa.	S. .050 max.; P. .040 max.; C. .40-.45; Mn. .75-1.00; Si. .15-.30; Cr. .80-1.10; Mo. .15-.25.	z	z	z	P, B.	B[15]	D	B[16]	3
4	AISI E-4337	U.S. Steel Corp., Pittsburgh, Pa.	S. .025 max.; P. .025 max.; C. .35-.45; Mn. .60-.80; Si. .15-.30; Ni. 1.65-2.00; Cr. .70-.90; Mo. .23-.30	z	z	z	P.	B[15]	D	D	4
5	ASTM A-203 Grade A(a)	U. S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .035 max.; C .17 max.; Mn. .80 max.; Si. .15-.30; Ni. 2.00-2.75	.55% T.S.	65-77	u	P.	B[15]	D	D	5
6	ASTM A-203 Grade B(a)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .035 max.; C. .20 max.; Mn. .80 max.; Si. .15-.30; Ni. 2.00-2.75	.55% T.S.	70-82	u	P.	B[15]	D	D	6
7	ASTM A-203 Grade C(a)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .035 max.; C. .25 max.; Mn. .80 max.; Si. .15-.30; Ni. 2.00-2.75	.55% T.S.	75-87	u	P.	B[15]	D	D	7
8	ASTM A-204 Grade A(b)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .035 max.; C. .18-.25 max.; Mn. .50-.90; Si. .15-.30; Mo. .40-.60.	.55% T.S.	65-77	v	P, B.	B[15]	D	D	8
9	ASTM A-204 Grade B(b)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .035 max.; C. .20-.27 max.; Mn. .50-.90; Si. .15-.30; Mo. .40-.60.	.55% T.S.	70-82	v	P, B.	B[15]	D	D	9
10	ASTM A-204 Grade C(b)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .035 max.; C. .23-.28 max.; Mn. .50-.90; Si. .15-.30; Mo. .40-.60.	.55% T.S.	75-87	v	P, B.	B[15]	D	D	10
11	ASTM A-225-39 Grade A(c)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .035 max.; C. .18 max.; Mn. 1.45 max.; Si. .15-.30; V. .08-.14.	.55% T.S.	70-82	v	P.	A	D	D	11

*Yield strength is that load which will produce an elongation of .002" in 1". The value is obtained from stress-strain curves, and is based on a 25,000,000 psi. Modulus of Elasticity.

**Single figure (50) indicates minimum value; double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P=plates, S=sheets, CR=cold rolled, HR=hot rolled, B=bars, W=wire, T=tubing, R=rods.

‡Welding Qualities: A=Readily weldable, B=Weldable under favorable conditions (see footnotes), C=Not ordinarily weldable, D=No welding data available, X=This method of gas welding may be applied successfully to the chromium nickel and straight chromium alloys under certain conditions; but it is not as well adapted for general work with these alloys as is the metallic arc method. It is frequently employed on 20 gauge and lighter material.

a. Nickel Steel to A.S.T.M. Specs., b. Carbon Moly to A.S.T.M. Specs., c. Manganese Vanadium to A.S.T.M. Specs., d. Chrome Moly to U.S. Army or Navy Specs., e. Manganese Vanadium to U.S. Navy Specs., u. 1,650,000/T.S., v. 1,750,000/T.S., w. 1,500,000/T.S., x. 2,000,000/T.S., y. used as furnished., z. usually heat treated.

1. Annealing suggested to remove brittleness and to improve ductility. 2. Post heat. 3. Unable to make ductile. 4. Preheat—cool slowly. 5. Pickled surface required. 6. Thin sections. 7. Heat treatment required. 8. Stress relieve after welding. 9. Impact strength increased by annealing. 10. Annealed. 11. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. Special welding technique required also. 12. Low preheat 100-300 F is desired or recommended during welding. 13. Low preheat 100-300 F is desired or recommended during welding in heavy sections. 14. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. 15. The necessity for stress relief annealing usually depends on the character of part and service. Adequate preheat can confer practically the same metallurgical advantages as part heating. 16. Can be flash welded. 17. Annealing necessary for maximum resistance to corrosion. 18. Use austenitic rod, e.g., 17 CR rod annealed.

WELDABLE ALLOY MATERIALS—FERROUS

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth.* 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
12	ASTM A-225-39 Grade B(c)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .035 max.; C. .20 max.; V. .08-.14	.55% T.S.	75-87	v	P.	B[15]	D	D	12
13	A.W. Dyn-El	Alan Wood Steel Co., Conshohocken, Pa.	C. .12; Mn. .60; P. .085; Cu. .40.	50	72	28	S, P.	A	A	A	13
14	Abrasion Resisting	Lukens Steel Co. Coatesville, Pa.	S. 0.34; P. .030; C. .43; Mn. 1.80; Si. .27	75	120	21	P.	B[11]	B[11]	D	14
15	Allegheny Metal 17-7	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .09-.20; Mn. 1.25; Max.; Ni. 7-9 Cr. 16-18	40	100	50	S, CR, B, W.	A	X	A	15
16	Allegheny Metal 18-8	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .08-.20; Mn. 1.25 Max.; Ni. 8-10; Cr. 17.5-20.0	35	80	50	S, P, CR, B, W.	A	X	A	16
17	Allegheny Metal 18-8-S	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .08 Max; Mn. 2.0 Max; Ni. 8-10; Cr. 18-20	30	75	50	S, P, CR, HR, B, W.	A	X	A	17
18	Allegheny Metal 20-10-S	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .08-Max.; Mn. 2.0 Max.; Ni. 10-12; Cr. 19-22	30	80	50	S, P, CR, HR, B, W.	A	X	A	18
19	Allegheny Metal 25-12	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .20 Max.; Ni. 12-14; Cr. 22-26	35	80	50	S, P, B, W.	A	X	A	19
20	Allegheny Metal 25-12S	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .08 Max.; Ni. 12-14; Cr. 22-26	35	80	50	S, P, B, W.	A	X	A	20
21	Allegheny Metal 25-20	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .25 Max.; Ni. 19-21; Cr. 24-26	35	80	50	S, P, HR, B, W.	A	X	A	21
22	Allegheny Metal 18-8-M	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .10 Max.; Ni. 10-14; Cr. 16-18; Mo. 2-3	35	80	50	S, P, CR, HR, B, W.	A	X	A	22
23	Allegheny Metal 18-8-M Spec.	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .10 Max; Ni. 10-14; Cr. 18-20; Mo. 3-4	35	80		S, P, CR, HR, B, W.	A	X	A	23
24	Allegheny Metal 18-8-T	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .10 Max; Ni. 7-10; Cr. 17-20; Ti. 4xC. Min.	35	75	50	S, P, CR, HR, B, W.	A	X	A	24
25	Allegheny Metal 18-8-C	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .10 Max.; Ni. 8-12; Cr. 17-20; Cb. 10 x C.	35	75	50	S, P, CR, HR, B, W.	A	X	A	25
26	Allegheny Metal 12-NH	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .08 Max.; Cr. 11.5-13.5; Al. .10-.20	35	60	25	S, P, CR, B, W.	A	X	B[1]	26
27	Allegheny Metal 12	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	S. .025 Max.; P. .025 Max.; C. .15 Max.; Mn. .50 Max.; Si. .50 Max.; Cr. 11.5-13.5	35	60	25	S, P, CR, HR, B, W.	A	X	B[1]	27
28	Allegheny Metal 17	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	S. .025 Max.; P. .025 Max.; C. .12 Max.; Mn. .50 Max.; Si. .50 Max.; Cr. 14-18	35	60	30	S, P, CR, HR, B, W.	A	X	B[1]	28
29	Allegheny Metal 21	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .35 Max.; Cr. 18-23	40	65	28	S, P, B, W.	A	X	B[1]	29
30	Allegheny Metal 28	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .35 Max.; Cr. 23-30	45	75	20	S, P, CR, HR, B, W.	A	X	B[1]	30
31	Allegheny Metal 46 Type 501.	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. over .10; Cr. 4-6	40	70	25	S, P, B, W.	A	X	B[1]	31
32	Allegheny Metal 46 Type 502.	Allegheny Ludlum Steel Corp., Pittsburgh, Pa.	C. .10 Max.; Cr. 4-6	35	60	30	S, P, HR, B, W.	A	X	B[1]	32

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
33	Armco Chromsteel	American Rolling Mill Co., Middletown, Ohio.	S. Min.; P. Min.; C. 0.06; Mn. 0.75; Si. 0.40; Cr. 11.5;	55	80	25	S, P,	B[2]	B[2]	B[2]	33
34	Armco Galv. Ingot Iron	American Rolling Mill Co., Middletown, Ohio	S. .025; P. .005; C. .015; Mn. .035; Si. .003	30	45	35	S, P.	A	A	D	34
35	Armco Galvanized C–B Steel	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .008; C. .070; Mn. .360; Si. .003; Cu. .20 Min.	30	45	29	S, P.	A	A	D	35
36	Armco Galvanized O–H Steel	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .008; C. .070; Mn. .360; Si. .003	30	45	32	S, P.	A	A	D	36
37	Armco Hot & Cold Rolled	American Rolling Mill Co., Middletown, Ohio.	P. .008-.025; C. .04-.08; Mn. .20-.50; Cu. as specified	28-85	45-85	40-4	S, P.	A	A	D	37
38	Armco High Tensile	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .10; C. .10; Mn. .45; Si. .08; Ni. .75; Cu. .60; Mo. .10	50 min.	65-75	28-25	S, P.	A	A	D	38
39	Armco Ingot Iron	American Rolling Mill Co., Middletown, Ohio.	S. .025; P. .005; C. .015; Mn. .035; Si. .003	30	45	35	S, P.	A	A	D	39
40	Armco Long Terne Sheets	American Rolling Mill Co., Middletown, Ohio.		26-57	30-45	26-44	S, P.	A	A	D	40
41	Armco Paintgrip Ingot Iron	American Rolling Mill Co., Middletown, Ohio	S. .025; P. .005; C. .015; Mn. .035; Si. .003	30	45	35	S, P.	A	A	D	41
42	Armco Paintgrip Copper Bearing Steel.	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .008; C. .070; Mn. .360; Si. .003; Cu. .20 Min.	30	45	29	S, P.	A	A	D	42
43	Armco Paintgrip O. H. Steel	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .008; C. .070; Mn. .360; Si. .003	30	45	32	S, P.	A	A	D	43
44	Armco Stainless Steel 17-7	American Rolling Mill Co., Middletown, Ohio.	S. .03 Max.; P. .03 Max.; C. .09-.20; Mn. .65; Si. .45; Ni. 7-9; Cr. 16-18;	45	90	55	S. P.	A	A	D	44
45	Armco Stainless Steel 18-8 Type 302	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. over .08-.20; Mn. 1.25 max.; Si. .30-.60; Ni. 8-10; Cr. 18-20	45	90	55-60	S. P.	A	A	D	45
46	Armco Stainless Steel 18-8, Type 304	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. .08 max.; Mn. 2.00 max.; Si. .30-.60; Ni. 8-10; Cr. 18-20	40	85	60-65	S. P.	A	A	D	46

*Yield strength is that load which will produce an elongation of .002″ in 1″. The value is obtained from stress-strain curves, and is based on a 25,000,000 psi. Modulus of Elasticity.

**Single figure (50) indicates minimum value; double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P = plates, S = sheets, CR = cold rolled, HR = hot rolled, B = bars, W = wire, T = tubing, R = rods.

‡‡Welding Qualities: A = Readily weldable, B = Weldable under favorable conditions (see footnotes), C = Not ordinarily weldable, D = No welding data available, X = This method of gas welding may be applied successfully to the chromium nickel and straight chromium alloys under certain conditions; but it is not as well adapted for general work with these alloys as is the metallic arc method. It is frequently employed on 20 gauge and lighter material.

a. Nickel Steel to A.S.T.M. Specs., b. Carbon Moly to A.S.T.M. Specs., c. Manganese Vanadium to A.S.T.M. Specs., d. Chrome Moly to U.S.Army or Navy Specs., e. Manganese Vanadium to U.S.Navy Specs., u. 1,650,000/T.S., v. 1,750,000/T.S., w. 1,500,000/T.S., x. 2,000,000/T.S.

1. Annealing suggested to remove brittleness and to improve ductility. 2. Post heat. 3. Unable to make ductile. 4. Preheat—cool slowly. 5. Pickled surface required. 6. Thin sections. 7. Heat treatment required. 8. Stress relieve after welding. 9. Impact strength increased by annealing. 10. Annealed. 11. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. Special welding technique required also. 12. Low preheat 100-300 F is desired or recommended during welding. 13. Low preheat 100-300 F is desired or recommended during welding in heavy sections. 14. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. 15. The necessity for stress relief annealing usually depends on the character of part and service. Adequate preheat can confer practically the same metallurgical advantages as part heating. 16. Can be flash welded. 17. Annealing necessary for maximum resistance to corrosion. 18. Use austenitic rod, e.g., 17 CR rod annealed.

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth.* 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
47	Armco Stainless Steel 25-12	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. .20 max.; Mn. 1.25; Si. .90; Ni. 12-14; Cr. 22-26	45	95	45	S. P.	A	A	D	47
48	Armco Stainless Steel 18-12 Mo.	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. .10 max; Mn. 2.00 max.; Si. .30-.60; Ni. 14 max.; Cr. 16-18; Mo. 2-3	40	85	45-55	S. P.	A	A	D	48
49	Armco Stainless Steel 19-12 Mo.	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. .10 max.; Mn. 2.00 max.; Si. .30-.60; Ni. 14 max; Cr. 18-20; Mo. 3-4	40	85	40-50	S. P.	A	A	D	49
50	Armco Stainless Steel 18-10 Ch.	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. .10 max.; Mn. 1.50 max.; Si. .75 max.; Ni. 8-12; Cr. 17-20; Cb. min. 10x carbon	40	85	45-55	S. P.	A	A	D	50
51	Armco Stainless Steel 27	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. .35 max.; Mn. .80 max.; Si. 1.00; Cr. 23-30	50	80	23	S. P.	B[3]	B[3]	B[3]	51
52	Armco Stainless Steel 17	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. .12 max.; Mn. .30-.60; Si. .50; Cr. 14-18	45	75	27	S. P.	B[3]	B[3]	B[3]	52
53	Armco Stainless Steel 13	American Rolling Mill Co., Middletown, Ohio.	S. .03 max.; P. .03 max.; C. .15 max.; Mn. .45; Si. .45; Cr. 10-14	35	65	30	S. P.	B[3]	B[3]	B[3]	53
54	Armco Zincgrip Ingot Iron	American Rolling Mill Co., Middletown, Ohio.	S. .025; P. .005; C. .015; Mn. .035; Si. .003	40	55	28	S. P.	A	A	A	54
55	Armco Zincgrip Copper Bearing Steel	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .008; C. .070; Mn. .360; Si. .003; Cu. .20 min.	45	60	28	S. P.	A	A	A	55
56	Armco Zincgrip O. H. Steel	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .008; C. .070; Mn. .360; Si. .003	45	60	30	S. P.	A	A	A	56
57	Armco Zincgrip-Paintgrip Ingot Iron	American Rolling Mill Co., Middletown, Ohio.	S. .025; P. .005; C. .015; Mn. .035; Si. .003	40	55	28	S. P.	A	A	A	57
58	Armco Zincgrip-Paintgrip Cu. Bear. Steel	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .008; C. .070; Mn. .360; Si. .003; Cu. .20 min.	45	60	28	S. P.	A	A	A	58
59	Armco Zincgrip-Paintgrip O. H. Steel	American Rolling Mill Co., Middletown, Ohio.	S. .030; P. .008; C. .070; Mn. .360; Si. .003	45	60	30	S. P.	A	A	A	59
60	"Band Hack"	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .1.25-1.32; Mn. .10-.25; Si. .10-.20; Cr. .10-.20	124.1	151.1	9.5	S, P, CR, HR, B.	B[4]	B[4]	B[4]	60
61	"Best Tool"	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .80-1.; Mn. .20-.40; Si. .15-.30; Ni. .10 max.; Cr. .10 max.	174	193.6	7	S, P, CR, B.	A	A	A	61
62	Carbon Molybdenum A-204-A	Lukens Steel Co., Coatesville, Pa.	S. .019; P. .019; C. .15; Mn. .80, Si. .22; Mo. .46	42	68	35	P	A	A	A	62
63	Carbon Molybdenum A-204-B	Lukens Steel Co., Coatesville, Pa.	S. .021; P. .018; C. .18; Mn. .83; Si. .20; Mo. .50	46	75	33	P	B[12]	B[12]	B[12]	63
64	Carbon Molybdenum A-204-C	Lukens Steel Co., Coatesville, Pa.	S. .025; P. .016; C. .20; Mn. .80; Si. .19; Mo. .52	54	81	28	P	B[14]	B[14]	B[14]	64
65	Carbon Moly. (under ¾ gage)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .040 max.; C. .18 max.; Mn. .80-1.10; Si. .15-.25; Mo. .40-.60.	43.5	72	W	P.	B[15]	D	D	65

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
66	Carbon Moly. (over ¾ gage)	U.S. Steel Corp., Pittsburgh, Pa.	S. .040 max.; P. .040 max.; C. .20 max.; Mn. .80-1.10; Si. .15-.25; Mo. .40-.60	40	70	W	P.	B[15]	D	D	66
67	Carbon Moly. High Manganese	U.S. Steel Corp., Pittsburgh, Pa.	S. 040 max.; P. .035 max.; C. .25 max.; Mn. 1.15-1.50; Si. .25 max.; Mo. .40-.60	65	80-105	X	P.	B[15]	D	D	67
68	Carbon Nickel	Lukens Steel Co., Coatesville, Pa.	S. .018; P. .014; C. .24; Mn. .62; Si. .22; Ni. 3.52	54	94	22	P	B[14]	B[14]	B[14]	68
69	Carbon-Silicon A-201-A	Lukens Steel Co., Coatesvile, Pa.	S. .03; P. .02; C. .18; Mn. .60; Si. .20	38	62	35	P	A	A	A	69
70	Carbon-Silicon A-201-B	Lukens Steel Co., Coatesville, Pa.	S. .035; P. .017; C. .22, Mn. .65; Si. .18	40	67	33	P	A	A	A	70
71	Carbon-Silicon A-212-A	Lukens Steel Co., Coatesville, Pa.	S. .032; P. .018; C. .25; Mn. .70; Si. .21	42	72	31	P	A	A	A	71
72	Carbon-Silicon A-212-B	Lukens Steel Co., Coatesville, Pa.	S. .031; P. .020; C. .28; Mn. .77; Si. .20	44.5	77	29	P	A[13]	A[13]	A[13]	72
73	Chromium Copper Nickel	Lukens Steel Co., Coatesville, Pa.	S. .029; P. .020; C. .14; Mn. .45; Si. .15; Ni. .50; Cr. .70; Cu. .62	43	73	30	P	A	A	A	73
74	Chromium Manganese	Lukens Steel Co., Coatesville, Pa.	S. .027; P. .023; C. .40; Mn. .98; Si. .21; Cr. .48	70	110	18	P	C	C	C	74
75	Cor-Ten	U. S. Steel Corp., Pittsburgh, Pa.	S. .04 max; P. .04 max; C. .30 max; Mn. 1.10-1.60; Si. .30 max; Cu. 30-50 Ni. .55 max; Cr. .50-1.50	50	70	22	S, P, CR, HR, B, W.	A	A	A	75
76	Cr-Mn-Si (CMS) A-202-A	Lukens Steel Co., Coatesville, Pa.	S. .030; P. .016; C. .16; Mn. 1.30; Si. .75; Cr. .50	54	85	24	P	B[14]	B[14]	B[14]	76
77	Cr-Mn-Si A-202-B	Lukens Steel Co., Coatesville, Pa.	S. .032; P. .019; C. .22; Mn. 1.27; Si. .80; Cr. .53	60	95	22	P	B[14]	B[14]	B[14]	77
78	Cumoloy	Republic Steel Corp., Massillon, Ohio.	S. .04 max.; P. .04 max.; C. .25 max.; Mn. .70-1.25; Si. .20 max; Cu. .65-.85; Mo. .20-.30	50	70	25	S, P, CR, B	A	D	A	78

*Yield strength is that load which will produce an elongation of .002" in 1". The value is obtained from stress-strain curves, and is based on a 25,000,000 psi. Modulus of Elasticity.

**Single figure (50) indicates minimum value; double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P=plates, S=sheets, CR=cold rolled, HR=hot rolled, B=bars, W=wire, T=tubing, R=rods.

‡‡Welding Qualities: A=Readily weldable, B=Weldable under favorable conditions (see footnotes), C=Not ordinarily weldable, D=No welding data available, X=This method of gas welding may be applied successfully to the chromium nickel and straight chromium alloys under certain conditions; but it is not as well adapted for general work with these alloys as is the metallic arc method. It is frequently employed on 20 gauge and lighter material.

a. Nickel Steel to A.S.T.M. Specs., b. Carbon Moly to A.S.T.M. Specs., c. Manganese Vanadium to A.S.T.M. Specs., d. Chrome Moly to U.S.Army or Navy Specs., e. Manganese Vanadium to U.S.Navy Specs., u. 1,650,000/T.S., v. 1,750,000/T.S., w. 1,500,000/T.S., x. 2,000,000/T.S.

1. Annealing suggested to remove brittleness and to improve ductility. 2. Post heat. 3. Unable to make ductile. 4. Preheat—cool slowly. 5. Pickled surface required. 6. Thin sections. 7. Heat treatment required. 8. Stress relieve after welding. 9. Impact strength increased by annealing. 10. Annealed. 11. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. Special welding technique required also. 12. Low preheat 100-300 F is desired or recommended during welding. 13. Low preheat 100-300 F is desired or recommended during welding in heavy sections. 14. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. 15. The necessity for stress relief annealing usually depends on the character of part and service. Adequate preheat can confer practically the same metallurgical advantages as part heating. 16. Can be flash welded. 17. Annealing necessary for maximum resistance to corrosion. 18. Use austenitic rod, e.g., 17 CR rod annealed.

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth.* 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
79	Disston 843	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .40-.50; Mn. .70-.90; Si. .40-.60; Cr. .70-.90	145.	168.1	10	S, P, CR, HR, B	B[4]	B[4]	D	79
80	Disston 844	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .95-1.05; Mn. .25-.35; Si. .20-.30; Cr. 1.00-1.25	123.5	165.4	12	S, P, CR, HR, B	B[4]	B[4]	D	80
81	Disston 845c	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .72; Mn. .67; Si. .29; Cr. 1.21; V. .24; Mo. .71	175	186	16	S, P, CR, HR, B	B[4]	B[4]	D	81
82	Disston 847	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .50-.60; Mn. .69-.89; Si. 1.24-1.49; Cr. .39-.59; V. .03-.15	131.2	173.1	10.5	S, P, B	B[4]	B[4]	D	82
83	Disston 857	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .44; Mn. .26; Si. .96; Cr. 8.77; Mo. 1.84; Cu. 1.83	168	227	11.3	S, P, CR	C	B[4]	D	83
84	Disston 858	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .70; Mn. .34; Si. .22; Ni. 2.08; V. .10; Mo. .10	160	175	19	S, P, CR	B[4]	B[4]	B[4]	84
85	Disston 859	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .86; Mn. .39; Si. .30; Ni. 2.11; V. .13	153.2	183.4	9.4	S, P, CR	B[4]	B[4]	B[4]	85
86	Disston Stainless A.	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .25; Ni. .13; Cr. 13.75.	148.5	174.2	4	S, P, CR, HR, B	B[4]	B[4]	D	86
87	Disston Stainless Iron.	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .10; Mn. .43; Si. .41; Ni. .41; Cr. 15.18.	103.1	121.	21	S, P, HR, B.	B[4]	B[4]	B[4]	87
88	Elkro	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .45-.55; Mn. .50-.80; Si. .20-.30; Cr. .80-1.10; V. .15-.25	138.4	159.2	10.5	S, P, CR, HR, B	B[4]	B[4]	D	88
89	Enduro	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .90-1.00; Mn. .15-.30; Si. .10-.20; V. .20-.30	183.8	203.6	6.5	S, P, CR, HR, B	A	A	B[4]	89
90	Enduro S-1	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .12 max.; Mn. .50 max.; Si. .50 max.; Cu. 10.0-14.0	35-45	65-85	25-35	S, P, CR, B, W	D	D	D	90
91	Enduro AA	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .12 max.; Mn. .50 max.; Si. .50 max.; Cu. 14.0-18.0	45-55	75-90	20-30	S, P, CR, B, W	D	D	D	91
92	Enduro HC	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .25 max.; Mn. .50 max.; Si. .50 max.; Cu. 23.0-30.0	45-60	75-95	20-30	S, P, CR, B, W	D	D	D	92
93	Enduro 18-8	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .20 max.; Mn. 2.00 max.; Si. .75 max.; Ni. 8.0-10.0; Cu. 17.5-20.0	35-45	80-90	55-60	S, P, CR, B, W	A	A	A	93
94	Enduro 18-8S	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .08 max.; Mn. 2.00; Ni. 8.0-10.0; Cu. 18.0-20.0; Si. .75	35-45	80-90	55-60	S, P, CR, B, W	A	A	A	94
95	Enduro 18-8S Ti	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .08 max.; Mn. 2.00 max.; Si. .75 max.; Ni. 8.0-10.0; Cu. 17.0-19.0	35-45	80-90	55-60	S, P, CR, B, W	A	A	A	95
96	Enduro 18-8 SCb	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .08 max.; Mn. 2.00; Si. .75; Ni. 8.0-12.0; Cu. 17.0-19.0	35-45	80-90	55-60	S, P, CR, B, W	A	A	A	96
97	Enduro 18-8 S Mo	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .08 max.; Mn. 2.00; Si. .75 max.; Ni. 9.0-14.0; Cu. 16.0-18.0; Mo. 2.0-3.0	35-45	80-90	55-60	S, P, CR, B, W	A	A	A	97

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
98	Enduro H C N	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .20 max.; Mn. 2.00 max.; Ni. 11.0-14.0; Cu. 22.0-26.0; Si. .75	40-60	90-110	50-65	S, P, CR, B, W	A	A	A	98
99	Enduro N C 3	Republic Steel Corp., Massillon, Ohio.	S. .030 max.; P. .030 max.; C. .25 max.; Mn. 2.00 max.; Si. .75; Ni. 19.0-21.0; Cu. 23.0-26.0	40-60	90-110	45-55	S, P, CR, B, W	A	A	A	99
100	Granite City Hi-Yield	Granite City Steel Co., Granite City, Ill.	S. .035; P. .080 max.; C. .18; Mn. 1.05; Si. .25; Cr. .10; Cu. .30	50	70	28	S, P, CR	A	A	B[5]	100
101	"Hack Saw"	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. 1.15-1.25; Mn. .25-.35; Si. .15-.25; Cr. .10-.20; W. .90-1.10	153.3	184	5.5	S	C	C	D	101
102	IngAclad Stainless Clad Steel Type 302	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .08-.20; Mn. 1.25; Si. .50; Ni. 8-10; Cr. 17.5-20	40-50	60-70	50-40	S, P	A	C	B[6]	102
103	IngAclad Stainless Clad Steel Type 304	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .08 max.; Mn. .60; Si. .50; Ni. 8-10; Cr. 18-20	40-50	60-70	50-40	S, P	A	C	B[6]	103
104	IngAclad Stainless Clad Steel Type 316	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .10 max.; Mn. .60; Si. .50, Ni. 10-14; Cr. 16-18; Mo. 2-3	40-50	60-70	50-40	S, P	A	C	B[6]	104
105	IngAclad Stainless Clad Steel Type 317	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .10 max., Mn. .60 Si. .50; Ni. 10-14; Cr. 18-20; Mo. 3-4	40-50	60-70	50-40	S, P	A	C	B[6]	105
106	IngAclad Stainless Clad Steel Type 347	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .10 max.; Mn. .60; Si. .50; Ni. 8-12; Cr. 17-20; Cb. 10XC	40-50	60-70	50-40	S, P	A	C	B[6]	106
107	Ingersoll Stainless Steel Type 302	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .08-.20; Mn. .60; Si. .50; Ni. 8-10; Cr. 17.5-20.	35-45	80-90	65-55	S	A	C	B[6]	107
108	Ingersoll Stainless Steel Type 304	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .08 max.; Mn. .60; Si. .50; Ni. 8-10; Cr. 18-20	35-45	80-90	65-55	S	A	C	B[6]	108
109	Ingersoll Stainless Steel Type 316	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .10 max.; Mn. .60; Si. .50; Ni. 10-14; Cr. 16-18; Mo. 2-3	35-50	80-90	65-55	S	A	C	B[6]	109
110	Ingersoll Stainless Steel Type 317	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .10 max.; Mn. .60; Si. .50; Ni. 10-14; Cr. 18-20; Mo. 3-4	35-55	80-90	65-55	S	A	C	B[6]	110

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**Single figure (50) indicates minimum value; double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P=plates, S=sheets, CR=cold rolled, HR=hot rolled, B=bars, W=wire, T=tubing, R=rods.

‡Welding Qualities: A=Readily weldable, B=Weldable under favorable conditions (see footnotes), C=Not ordinarily weldable, D=No welding data available, X=This method of gas welding may be applied successfully to the chromium nickel and straight chromium alloys under certain conditions; but it is not as well adapted for general work with these alloys as is the metallic arc method. It is frequently employed on 20 gauge and lighter material.

a. Nickel Steel to A.S.T.M. Specs., b. Carbon Moly to A.S.T.M. Specs., c. Manganese Vanadium to A.S.T.M. Specs., d. Chrome Moly to U.S. Army or Navy Specs., e. Manganese Vanadium to U.S. Navy Specs., u. 1,650,000/T.S., v. 1,750,000/T.S., w. 1,500,000/T.S., x. 2,000,000/T.S.

1. Annealing suggested to remove brittleness and to improve ductility. 2. Post heat. 3. Unable to make ductile. 4. Preheat—cool slowly. 5. Pickled surface required. 6. Thin sections. 7. Heat treatment required. 8. Stress relieve after welding. 9. Impact strength increased by annealing. 10. Annealed. 11. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. Special welding technique required also. 12. Low preheat 100-300 F is desired or recommended during welding. 13. Low preheat 100-300 F is desired or recommended during welding in heavy sections. 14. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. 15. The necessity for stress relief annealing usually depends on the character of part and service. Adequate preheat can confer practically the same metallurgical advantages as part heating. 16. Can be fish welded. 17. Annealing necessary for maximum resistance to corrosion. 18. Use austenitic rod, e.g., 17 CR rod annealed.

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth.* 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
111	Ingersoll Stainless Steel Type 347	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .10 max.; Mn. .60; Si. .50; Ni. 8-12; Cr. 17-20; Cb. 10XC	35-45	80-90	60-55	S	A	C	B[6]	111
112	Ingersoll Stainless Steel Type 309	Ingersoll Steel & Disc, Chicago	S. .030; P. .030; C. .20 max.; Mn. .60; Si. .50; Ni. 12-14; Cr. 22-26	40-60	90-110	65-50	S	A	C	D	112
113	Inland Hi-Steel	Inland Steel Co., Chicago	S. .025; P. .095; C. .09; Mn. .60; Si. .05; Ni. .60; Cu. 1.05	62	74	26	S, P, CR, HR, B, W	A	A	A	113
114	Keystone Chisel	Henry Disston & Sons, Phila., Pa.	S. .025; P. .025; C. .45-.55; Mn. .20-.35; Si. .15-.25; Cr. 1.00-1.20; W. 1.80-2.10; V. .10-.25	158	168.3	13	S, P, HR, B	B[4]	B[4]	D	114
115	Kut-Kwick	Henry Disston & Sons, Phila., Pa.	S. .025; P. .025; C. .76-.80; Mn. .20-.30; Si. .20-.30; Cr. 3.50-4.00; W. 17.5-19.0; V. .75-1.20	228.7	252.4	3.65	S, P, B	C	C	C	115
116	Lo Cro 46 Mo Type 501	Crucible Steel Co., of America, N. Y.	C. over 0.10; Cr. 4-6; Mo. 0.40-0.60	25-35	60-145	40-30	S, P	A	X	B[7]	116
117	Lo Cro 46 Mo Type 502	Crucible Steel Co., of America, N. Y.	C. 0.10 max.; Cr. 4-6; Mo. 0.40-0.60	25-35	60-80	40-30	S, P	A	X	B[7]	117
118	Low Carbon Nickel A-203-A	Lukens Steel Co., Coatesville, Pa.	S. .027; P. .016; C. .16; Mn. .65; Si. .19; Ni. 2.40	41	72.5	35	P	A	A	A	118
119	Low Carbon Nickel A-203-B	Lukens Steel Co., Coatesville, Pa.	S. .030; P. .015; C. .19; Mn. .70; Si. .22; Ni. 2.61	43	77	32	P	B[12]	B[12]	B[12]	119
120	Low Carbon Nickel A-203-C	Lukens Steel Co., Coatesville, Pa.	S. .028; P. .016; C. .23; Mn. .73; Si. .20; Ni. 2.51	49	85	29	P	B[14]	B[14]	B[14]	120
121	Low Chromium Molybdenum	Lukens Steel Co., Coatesville, Pa.	S. .027; P. .021; C. 15; Mn. .81; Si. .20; Cr. .42; Mo. .23	43.5	73	31	P	A	A	A	121
122	Manganese Molybdenum A	Lukens Steel Co., Coatesville, Pa.	S. .030; P. .015; C. .15; Mn. 1.10; Si. .17; Mo. .42	55	80	34	P	A[13]	A[13]	A[13]	122
123	Manganese Molybdenum B	Lukens Steel Co., Coatesville, Pa.	S. .032; P. .018; C. .19; Mn. 1.30; Si. .20 Mo. .47	60	88	30	P	B[13]	B[13]	B[13]	123
124	Manganese Molybdenum C	Lukens Steel Co., Coatesville, Pa.	S. .030; P. .020; C. .22; Mn. 1.50; Si. .21; Mo. .52	70	100	25	P	B[14]	B[14]	B[14]	124
125	Manganese-Vanadium.	Lukens Steel Co., Coatesville, Pa.	S. .026; P. .018; C. .17; Mn. 1.30; Si. .22; V. .10.	55	84	28	P	A[13]	A[13]	A[13]	125
126	Mansil	Henry Disston & Sons, Phila., Pa.	S. .025; P. .025; C. .85-.95; Mn. 1.00-1.25; Si. .25-.45; Cr. .40-.60; W. .40-.60	157.5	185.1	5.5	S, P, HR, B	C	B[4]	D	126
127	Man-Ten	U. S. Steel Corp., Pittsburgh, Pa.	C. 0.30 max.; Mn. 1.10-1.60; Si. 0.30 max.; Cu. 0.20 min.; P. 0.04 max.	50	75	20	S, P, HR, B	A	A	A	127

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
128	Mayari R	Bethlehem Steel Co., Bethlehem, Pa.	C. 0.12 max.; Mn. 0.50-1.00; Si. 0.05-0.50; Cu. 0.50-0.70, Ni. 0.25-0.75; P.0.08-0.12; Cr. 0.20-1.00	50	70	22	S, P, CR, HR	A	A	A	128
129	N-A-X High Tensile	Great Lakes Steel Corp. Ecorse, Detroit, Mich.	S. .04 max.; P. .04 max.; C. .10-.18; Mn. .50-.75; Si. .70-.90; Cr. .50-.65; Zr. .10-.20; Mo. .10-.20	50	70	30	S, P, CR, HR, B, W, T	A	A	A	129
130	3-½% Nickel (SAE 2315)	Lukens Steel Co. Coatesville, Pa.	S. 031; P. .015; C. .14; Mn. .42; Si. .18; Ni. 3.41	50	80	25	P	B[14]	B[14]	B[14]	130
131	Nichroman	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .65-.75; Mn. .35-.40; Si. .10-.25; Ni. 1.55-1.75; Cr. .90-1.10; Cu. .25-.45	186	206.9	6	S, P, CR, HR, B	B[4]	B[4]	D	131
132	Nivan	Henry Disston & Sons, Tacony, Phila., Pa.	S. .025; P. .025; C. .85-.95; Mn. .25-.35; Si. .20-.30, Ni. 1.25-1.50; Cr. .30-.45	138	182.1	8	S, P, CR, B	B[4]	B[4]	D	132
133	Otiscoloy	Otis Steel Co., Cleveland, Ohio	S. .045 max.; C. .10; Mn. 1.25; Si. .05; Ni. .10; Cr. .05; Cu. .30; P. .12	50	70	25	S, P, CR	A	A	A	133
134	Polaris	Henry Disston & Sons Tacony, Phila., Pa.	S. .025; P. .025; C. .88; Mn. .33; Si. .34; Ni. .75; Cr. .26; V. .07; Mo. .16	140.8	179.5	10	S, P, CR, HR, B	B[4]	B[4]	B[4]	134
135	Republic Double Strength #1	Republic Steel Corp., Massillon, Ohio.	S. .04 max.; P. .04 max.; C. .12 max.; Mn. .50-1.0; Si. .04 max.; Ni. .50-1.5; Cu. .50-1.5; Mo. .10 min.	50	70	25	S, P, CR, B	A	A	A	135
136	Republic Double Strength #1 A	Republic Steel Corp., Massillon, Ohio	S. .04 max.; P. .04 max.; C. .30 max.; Mn. .50-1.0; Si. .04 max.; Ni. .50-1.5; Cu. .50-1.5; Mo. .10 min.	70	90	15	S, P, CR, B	A[8]	D	B[3]	136
137	Rezistal Grade "A"	Crucible Steel Co. of America, New York	C. 30-40; Cr. 12-14	60-200	95-300	30-2	S, P	B	X	B[7]	137
138	Rezistal Grade "B"	Crucible Steel Co. of America, New York	C. 50-70; Cr. 14-18	50-250	90-300	1-35	S, P	B	X	B[7]	138

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†Available forms: P=plates, S=sheets, CR=cold rolled, HR=hot rolled, B=bars, W=wire, T=tubing, R=rods.

‡‡Welding Qualities: A=Readily weldable, B=Weldable under favorable conditions (see footnotes), C=Not ordinarily weldable, D=No welding data available, X=This method of gas welding may be applied successfully to the chromium nickel and straight chromium alloys under certain conditions; but it is not as well adapted for general work with these alloys as is the metallic arc method. It is frequently employed on 20 gauge and lighter material.

a. Nickel Steel to A.S.T.M. Specs., b. Carbon Moly to A.S.T.M. Specs., c. Manganese Vanadium to A.S.T.M. Specs., d. Chrome Moly to U.S.Army or Navy Specs., e. Manganese Vanadium to U.S.Navy Specs., u. 1,650,000/T.S., v. 1,750,000/T.S., w. 1,500,000/T.S., x. 2,000,000/T.S.

1. Annealing suggested to remove brittleness and to improve ductility. 2. Post heat. 3. Unable to make ductile. 4. Preheat—cool slowly. 5. Pickled surface required. 6. Thin sections. 7. Heat treatment required. 8. Stress relieve after welding. 9. Impact strength increased by annealing. 10. Annealed. 11. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. Special welding technique required also. 12. Low preheat 100-300 F is desired or recommended during welding. 13. Low preheat 100-300 F is desired or recommended during welding in heavy sections. 14. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. 15. The necessity for stress relief annealing usually depends on the character of part and service. Adequate preheat can confer practically the same metallurgical advantages as part heating. 16. Can be flash welded. 17. Annealing necessary for maximum resistance to corrosion. 18. Use austenitic rod, e.g., 17 CR rod annealed.

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
139	Rezistal FM 188	Crucible Steel Co. of America, New York	C. 0.20 max.; Ni. 8-10; Cr. 17.5-20; Mo. 0.60 max.; S. 0.07 min.	30-40	75-90	60-55	S, P	A	X	B[7]	139
140	Rezistal KA2	Crucible Steel Co. of America, New York	C. 0.20; Mn. 1.25 max.; Ni. 8-10; Cr. 17-20	30-150	75-180	60-10	S, P	A	X	B[7]	140
141	Rezistal KA2S	Crucible Steel Co. of America, New York	C. 0.08 max.; Mn. 2.0 max.; Cr. 18-20				S, P	A	X	A	141
142	Rezistal KA2SMo	Crucible Steel Co. of America, New York	C. 0.10 max.; Ni. 10-14; Cr. 16-20; Mo. 2-4	40-50	90-100	60-50	S, P	A	X	A	142
143	Rezistal KA2SCb	Crucible Steel Co. of America, New York	C. 0.10 max.; Ni. 8-12; Cr. 17-20; Cb. 10 C min.	30-40	75-95	60-55	S, P	A	X	A	143
144	Rezistal KA2ST	Crucible Steel Co. of America, New York	C. 0.10 max.; Ni. 7-10; Cr. 17-20; T. 4C min.	30-40	75-95	60-55	S, P	A	X	A	144
145	Rezistal 2 C	Crucible Steel Co. of America, New York	C. over 0.08; Mn. 1.25 max.; Si. 2-3; Ni. 8-10; Cr. 18-20	40-50	90-100	60-50	S, P	A	X	A	145
146	Rezistal 3	Crucible Steel Co. of America, New York	C. 0.20 max.; Ni. 12-14; Cr. 22-26	40-50	95-105	40	S, P	A	X	A	146
147	Rezistal 4	Crucible Steel Co. of America, New York	C. 0.25 max.; Ni. 24-26; Cr. 19-21	45-50	90-110	40-30	S, P	A	X	A	147
148	Rezistal 7	Crucible Steel Co. of America, New York	C. 0.25 max.; Ni. 19-21; Cr. 24-26	45-55	100-110	55-45	S, P	A	X	A	148
149	Rezistal 12	Crucible Steel Co. of America, New York	C. 0.15 max.; Cr. 10-14	40-170	70-185	35-10	S, P	A	X	B[7]	149
150	Rezistal 17	Crucible Steel Co. of America, New York	C. 0.12 max.; Cr. 14-18	45-55	75-85	40-30	S, P	A	X	B[9]	150
151	Rezistal 20	Crucible Steel Co. of America, New York	C. 0.35 max.; Cr. 18-23	45-55	75-85	40-30	S, P	A	X	B[7]	151
152	Rezistal 27	Crucible Steel Co. of America, New York	C. 0.35 max.; Cr. 23-30	55-65	80-90	30-20	S. P	A	X	B[7]	152
153	Rezistal 162	Crucible Steel Co. of America, New York	C. 0.15 max.; Ni. 2.00 max.; Cr. 14-18	85-170	105-200	15-30	S, P	A	X	B[9]	153
154	Rezistal 329	Crucible Steel Co. of America, New York	Ni. 3-5; Cr. 25-30; Mo. 1.-1.5	85-95	105-125	30-20	S, P	A	X	A	154
155	Rezistal 2600	Crucible Steel Co. of America, New York	C. 0.30-0.50; Ni. 19-23; Cr. 7-10; Cu. 1.-1.5	45-55	85-95	40-30	S, P	A	X	A	155
156	Stainless Steel 301		Fe; Cr. 16-18; Ni. 7-9; C. 0.09-0.20; Min. 1.25 max.	45	90	55	S, P, CR, HR, B, W	A	X	A	156
157	Stainless Steel 302	The stainless steels are grouped here in accordance to type numbers assigned by the American Iron and Steel Institute. According to reports of this survey these stainless steels are generally available from the following producers. Allegheny-Ludlum Steel Corp., Pittsburgh, Pa. American Rolling Mill Co., Middletown, Ohio. Henry Disston & Sons, Philadelphia, Pa. Ingersoll Steel & Disc Div., Borg-Warner Corp., New Castle, Ind. Republic Steel Corp., Massillon, Ohio. United States Steel Corp., Pittsburgh, Pa.	Fe; Cr. 17.5-20; Ni.8-10; C. 0.08-0.20; Mn. 1.25 max.	45	90	55-60	S, P, CR, HR, B, W, T	A	X	A	157
158	Stainless Steel 302B		Fe; Cr. 17.5-20.; Ni. 8-10; C. 0.08; Si. 2-3; Mn. 1.25 max.	40-50	80-100	60-50	S, P, CR, HR, B, W	D	X	B[1]	158
159	Stainless Steel 303		Fe; Cr. 17.5-20; Ni. 8-10; C. 0.2 max; S or Se. 0.07 min.; or Mo. 0.60 max.	35-45	80-90	60-50	S, P, CR, HR, B, W	D	X	B[1]	159
160	Stainless Steel 304		Fe.; Cr. 18-20; Ni. 8-10; C. 0.08 max.; Mn. 2.0 max.	35-45	80-95	55-60	S, P, CR, HR, B, W, T	A	X	A	160
161	Stainless Steel 308		Fe; Cr. 19-22; Ni. 10-12; C. 0.08 max; Mn. 2 max.	30-40	80-90	55-65	S, P, CR, HR, B, W, T	A	X	A	161
162	Stainless Steel 309		Fe. Cr. 22-26; Ni. 12-14; C. 0.20 max.	45	95	45	S, P, CR, HR, B, W	A	X	A	162
163	Stainless Steel 310		Fe; Cr. 24-26; Ni. 19-21; C. 0.25 max.	40-60	90-110	55-45	S, P, CR, HR, B, W, T	A	X	A	163
164	Stainless Steel 311		Fe; Cr. 19-21; Ni. 24-26; C. 0.25 max.	45-50	90-110	30-40	S, P, CR, HR, B, W	A	X	A	164
165	Stainless Steel 312		Fe; Cr. 27-31; Ni. 8-10; C. 0.25 max.				S, P, B, W	D	X	D	165
166	Stainless Steel 315		Fe; Cr. 17-19; Ni. 7-9.5; C. 0.15 max; Cu. 1-1.5; Mo. 1-1.5	56	101	40	S, P, B, HR	D	X	B[1]	166

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
167	Stainless Steel 316		Fe; Cr. 16-18; Ni. 10-14; C. 0.10 max.; Mo. 2-3	40	85	45-55	S, P, CR, HR, B, W, T	A	X	A	167
168	Stainless Steel 317		Fe; Cr. 18-20; Ni. 10-14; C. 0.10 max.; Mo. 3-4	40	85	40-50	S, P, CR, HR, B, W, T	A	X	A	168
169	Stainless Steel 321		Fe; Cr. 17-20; Ni. 7-10; C. 0.10 max.; Ti. min. 4 x C	35-45	80-90	60-55	S, P, CR, HR, B, W, T	A	X	A	169
170	Stainless Steel 325		Fe; Cr. 7-10; Ni. 19-23; C. 0.25 max.; Cu. 1-1.5	45-55	85-95	30-40	S, P, CR, HR, B, W	A	X	A	170
171	Stainless Steel 329	The stainless steels are grouped here in accordance to type numbers assigned by the American Iron and Steel Institute. According to reports of this survey these stainless steels are generally available from the following producers. Allegheny-Ludlum Steel Corp., Pittsburgh, Pa. American Rolling Mill Co., Middletown, Ohio. Henry Disston & Sons, Philadelphia, Pa. Ingersoll Steel & Disc Div., Borg-Warner Corp., New Castle, Ind. Republic Steel Corp., Massillon, Ohio. United States Steel Corp., Pittsburgh, Pa.	Fe; Cr. 25-30; Ni. 3-5; C. 0.10 max.; Mo. 1-1.5	75	100	20	S, P, CR, HR, B, W	A	X	A	171
172	Stainless Steel 347		Fe; Cr. 17-20; Ni. 8-12; C. 0.10 max.; Cb 10 x C	40	85	45-55	S, P. Cr, HR, B, W, T	A	X	A	172
173	Stainless Steel 403		Fe; Cr. 11.5-13; C. 0.15 max.	35-45	65-85	25-35	S, P, Cr, HR, B, W, T				173
174	Stainless Steel 410		Fe; Cr. 10-14; C. 0.15 max.	35	65	30	S, P, CR, HR, B, W, T	A	X	B[1]	174
175	Stainless Steel 414		Fe; Cr. 10-14; Ni. 2 max.; C.0.15 max.	113	128	20	S, P, HR, B, W.	A	X	B[1]	175
176	Stainless Steel 416		Fe; Cr. 12-14; C. 0.15 max.; S. or Se. 0.07 min. or Mo. 0.60 max.	40-60	70-85	35-25	S, P, CR, HR, B, W, T	D	X	B[1]	176
177	Stainless Steel 420		Fe; Cr. 12-14; C. 0.15	55-185	105-225	23-8	S, P, CR, HR, B, W	A	X	B[7]	177
178	Stainless Steel 420F		Fe; Cr. 12-14; C. 0.15; S. or Se. 0.07 min. or Mo. 0.60 max.	76	134	6.5		A	X	B[1]	178
179	Stainless Steel 430		Fe; Cr. 14-18; C. 0.12 max.	45	75	27	S, P, CR, HR, B, W, T	A	X	B[1]	179
180	Stainless Steel 430F		Fe; Cr. 14-18; C. 0.12 max.; S. or Se. 0.07 min. or Mo. 0.60 max.	40-55	70-90	30-20	CR, HR, B, W	D	X	B[1]	180
181	Stainless Steel 440		Fe; Cr. 14-18; C. 0.12	60-190	100-250	23-3	S, CR, HR, B, W	D	X	B[1]	181
182	Stainless Steel 441		Fe; Cr. 14-18; Ni. 2 max.; C. 0.15	186	235	6	S, P, CR, HR, B, W	D	X	B[1]	182
183	Stainless Steel 442		Fe; Cr. 18-23; C. 0.35 max.	55	80	35	S, P, CR, HR, B	A	X	B[1]	183
184	Stainless Steel 446		Fe; Cr. 23-30; C. 0.35 max.	50	80	23	S, P, CR, HR, B, W, T	A	X	B[1]	184
185	Stainless Steel 501		Fe; Cr. 4-6; C. 0.10	25	60	30	S, P, CR, HR, B, W, T	A	X	B[1]	185
186	Stainless Steel 502		Fe; Cr. 4-6; C. 0.10 max.	25	60	30	S, P, CR, HR, B, W, T	A	X	B[1]	186

*Yield strength is that load which will produce an elongation of .002" in 1". The value is obtained from stress-strain curves, and is based on a 25,000,000 psi. Modulus of Elasticity.

**Single figure (50) indicates minimum value; double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P = plates, S = sheets, CR = cold rolled, HR = hot rolled, B = bars, W = wire, T = tubing, R = rods.

‡‡Welding Qualities: A = Readily weldable, B = Weldable under favorable conditions (see footnotes), C = Not ordinarily weldable, D = No welding data available, X = This method of gas welding may be applied successfully to the chromium nickel and straight chromium alloys under certain conditions; but it is not as well adapted for general work with these alloys as is the metallic arc method. It is frequently employed on 20 gauge and lighter material.

a. Nickel Steel to A.S.T.M. Specs., b. Carbon Moly to A.S.T.M. Specs., c. Manganese Vanadium to A.S.T.M. Specs., d. Chrome Moly to U.S.Army or Navy Specs., e. Manganese Vanadium to U.S.Navy Specs., u. 1,650,000/T.S., v. 1,750,000/T.S., w. 1,500,000/T.S., x. 2,000,000/T.S.

1. Annealing suggested to remove brittleness and to improve ductility. 2. Post heat. 3. Unable to make ductile. 4. Preheat—cool slowly. 5. Pickled surface required. 6. Thin sections. 7. Heat treatment required. 8. Stress relieve after welding. 9. Impact strength increased by annealing. 10. Annealed. 11. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. Special welding technique required also. 12. Low preheat 100-300 F is desired or recommended during welding. 13. Low preheat 100-300 F is desired or recommended during welding in heavy sections. 14. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. 15. The necessity for stress relief annealing usually depends on the character of part and service. Adequate preheat can confer practically the same metallurgical advantages as part heating. 16. Can be flash welded. 17. Annealing necessary for maximum resistance to corrosion. 18. Use austenitic rod, e.g., 17 CR rod annealed.

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
139	Rezistal FM 188	Crucible Steel Co. of America, New York	C. 0.20 max.; Ni. 8-10; Cr. 17.5-20; Mo. 0.60 max.; S. 0.07 min.	30-40	75-90	60-55	S, P	A	X	B[7]	139
140	Rezistal KA2	Crucible Steel Co. of America, New York	C. 0.20; Mn. 1.25 max.; Ni. 8-10; Cr. 17-20	30-150	75-180	60-10	S, P	A	X	B[7]	140
141	Rezistal KA2S	Crucible Steel Co. of America, New York	C. 0.08 max.; Mn. 2.0 max.; Cr. 18-20				S, P	A	X	A	141
142	Rezistal KA2SMo	Crucible Steel Co. of America, New York	C. 0.10 max.; Ni. 10-14; Cr. 16-20; Mo. 2-4	40-50	90-100	60-50	S, P	A	X	A	142
143	Rezistal KA2SCb	Crucible Steel Co. of America, New York	C. 0.10 max.; Ni. 8-12; Cr. 17-20; Cb. 10 C min.	30-40	75-95	60-55	S, P	A	X	A	143
144	Rezistal KA2ST	Crucible Steel Co. of America, New York	C. 0.10 max.; Ni. 7-10; Cr. 17-20; T. 4C min.	30-40	75-95	60-55	S, P	A	X	A	144
145	Rezistal 2 C	Crucible Steel Co. of America, New York	C. over 0.08; Mn. 1.25 max.; Si. 2-3; Ni. 8-10; Cr. 18-20	40-50	90-100	60-50	S, P	A	X	A	145
146	Rezistal 3	Crucible Steel Co. of America, New York	C. 0.20 max.; Ni. 12-14; Cr. 22-26	40-50	95-105	40	S, P	A	X	A	146
147	Rezistal 4	Crucible Steel Co. of America, New York	C. 0.25 max.; Ni. 24-26; Cr. 19-21	45-50	90-110	40-30	S, P	A	X	A	147
148	Rezistal 7	Crucible Steel Co. of America, New York	C. 0.25 max.; Ni. 19-21; Cr. 24-26	45-55	100-110	55-45	S, P	A	X	A	148
149	Rezistal 12	Crucible Steel Co. of America, New York	C. 0.15 max.; Cr. 10-14	40-170	70-185	35-10	S, P	A	X	B[7]	149
150	Rezistal 17	Crucible Steel Co. of America, New York	C. 0.12 max.; Cr. 14-18	45-55	75-85	40-30	S, P	A	X	B[9]	150
151	Rezistal 20	Crucible Steel Co. of America, New York	C. 0.35 max.; Cr. 18-23	45-55	75-85	40-30	S, P	A	X	B[7]	151
152	Rezistal 27	Crucible Steel Co. of America, New York	C. 0.35 max.; Cr. 23-30	55-65	80-90	30-20	S. P	A	X	B[7]	152
153	Rezistal 162	Crucible Steel Co. of America, New York	C. 0.15 max.; Ni. 2.00 max.; Cr. 14-18	85-170	105-200	15-30	S, P	A	X	B[9]	153
154	Rezistal 329	Crucible Steel Co. of America, New York	Ni. 3-5; Cr. 25-30; Mo. 1.-1.5	85-95	105-125	30-20	S, P	A	X	A	154
155	Rezistal 2600	Crucible Steel Co. of America, New York	C. 0.30-0.50; Ni. 19-23; Cr. 7-10; Cu. 1.-1.5	45-55	85-95	40-30	S, P	A	X	A	155
156	Stainless Steel 301	The stainless steels are grouped here in accordance to type numbers assigned by the American Iron and Steel Institute. According to reports of this survey these stainless steels are generally available from the following producers. Allegheny-Ludlum Steel Corp., Pittsburgh, Pa. American Rolling Mill Co., Middletown, Ohio. Henry Disston & Sons, Philadelphia, Pa. Ingersoll Steel & Disc Div., Borg-Warner Corp., New Castle, Ind. Republic Steel Corp., Massillon, Ohio. United States Steel Corp., Pittsburgh, Pa.	Fe; Cr. 16-18; Ni. 7-9; C. 0.09-0.20; Min. 1.25 max.	45	90	55	S, P, CR, HR, B, W	A	X	A	156
157	Stainless Steel 302		Fe; Cr. 17.5-20; Ni.8-10; C. 0.08-0.20; Mn. 1.25 max.	45	90	55-60	S, P, CR, HR, B, W, T	A	X	A	157
158	Stainless Steel 302B		Fe; Cr. 17.5-20.; Ni. 8-10; C. 0.08; Si. 2-3; Mn. 1.25 max.	40-50	80-100	60-50	S, P, CR, HR, B, W	D	X	B[1]	158
159	Stainless Steel 303		Fe; Cr. 17.5-20; Ni. 8-10; C. 0.2 max; S or Se. 0.07 min.; or Mo. 0.60 max.	35-45	80-90	60-50	S, P, CR, HR, B, W	D	X	B[1]	159
160	Stainless Steel 304		Fe.; Cr. 18-20; Ni. 8-10; C. 0.08 max.; Mn. 2.0 max.	35-45	80-95	55-60	S, P, CR, HR, B, W, T	A	X	A	160
161	Stainless Steel 308		Fe; Cr. 19-22; Ni. 10-12; C. 0.08 max; Mn. 2 max.	30-40	80-90	55-65	S, P, CR, HR, B, W, T	A	X	A	161
162	Stainless Steel 309		Fe. Cr. 22-26; Ni. 12-14; C. 0.20 max.	45	95	45	S, P, CR, HR, B, W	A	X	A	162
163	Stainless Steel 310		Fe; Cr. 24-26; Ni. 19-21; C. 0.25 max.	40-60	90-110	55-45	S, P, CR, HR, B, W, T	A	X	A	163
164	Stainless Steel 311		Fe; Cr. 19-21; Ni. 24-26; C. 0.25 max.	45-50	90-110	30-40	S, P, CR, HR, B, W	A	X	A	164
165	Stainless Steel 312		Fe; Cr. 27-31; Ni. 8-10; C. 0.25 max.				S, P, B, W	D	X	D	165
166	Stainless Steel 315		Fe; Cr. 17-19; Ni. 7-9.5; C. 0.15 max; Cu. 1-1.5; Mo. 1-1.5	56	101	40	S, P, B, HR	D	X	B[1]	166

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
167	Stainless Steel 316	The stainless steels are grouped here in accordance to type numbers assigned by the American Iron and Steel Institute. According to reports of this survey these stainless steels are generally available from the following producers. Allegheny-Ludlum Steel Corp., Pittsburgh, Pa. American Rolling Mill Co., Middletown, Ohio. Henry Disston & Sons, Philadelphia, Pa. Ingersoll Steel & Disc Div., Borg-Warner Corp., New Castle, Ind. Republic Steel Corp., Massillon, Ohio. United States Steel Corp., Pittsburgh, Pa.	Fe; Cr. 16-18; Ni. 10-14; C. 0.10 max.; Mo. 2-3	40	85	45-55	S, P, CR, HR, B, W, T	A	X	A	167
168	Stainless Steel 317		Fe; Cr. 18-20; Ni. 10-14; C. 0.10 max.; Mo. 3-4	40	85	40-50	S, P, CR, HR, B, W, T	A	X	A	168
169	Stainless Steel 321		Fe; Cr. 17-20; Ni. 7-10; C. 0.10 max.; Ti. min. 4 x C	35-45	80-90	60-55	S, P, CR, HR, B, W, T	A	X	A	169
170	Stainless Steel 325		Fe; Cr. 7-10; Ni. 19-23; C. 0.25 max.; Cu. 1-1.5	45-55	85-95	30-40	S, P, CR, HR, B, W	A	X	A	170
171	Stainless Steel 329		Fe; Cr. 25-30; Ni. 3-5; C. 0.10 max.; Mo. 1-1.5	75	100	20	S, P, CR, HR, B, W	A	X	A	171
172	Stainless Steel 347		Fe; Cr. 17-20; Ni. 8-12; C. 0.10 max.; Cb 10 x C	40	85	45-55	S, P. Cr, HR, B, W, T	A	X	A	172
173	Stainless Steel 403		Fe; Cr. 11.5-13; C. 0.15 max.	35-45	65-85	25-35	S, P, Cr, HR, B, W, T				173
174	Stainless Steel 410		Fe; Cr. 10-14; C. 0.15 max.	35	65	30	S, P, CR, HR, B, W, T	A	X	B[1]	174
175	Stainless Steel 414		Fe; Cr. 10-14; Ni. 2 max.; C.0.15 max.	113	128	20	S, P, HR, B, W.	A	X	B[1]	175
176	Stainless Steel 416		Fe; Cr. 12-14; C. 0.15 max.; S. or Se. 0.07 min. or Mo. 0.60 max.	40-60	70-85	35-25	S, P, CR, HR, B, W, T	D	X	B[1]	176
177	Stainless Steel 420		Fe; Cr. 12-14; C. 0.15	55-185	105-225	23-8	S, P, CR, HR, B, W	A	X	B[7]	177
178	Stainless Steel 420F		Fe; Cr. 12-14; C. 0.15; S. or Se. 0.07 min. or Mo. 0.60 max.	76	134	6.5		A	X	B[1]	178
179	Stainless Steel 430		Fe; Cr. 14-18; C. 0.12 max.	45	75	27	S, P, CR, HR, B, W, T	A	X	B[1]	179
180	Stainless Steel 430F		Fe; Cr. 14-18; C. 0.12 max.; S. or Se. 0.07 min. or Mo. 0.60 max.	40-55	70-90	30-20	CR, HR, B, W	D	X	B[1]	180
181	Stainless Steel 440		Fe; Cr. 14-18; C. 0.12	60-190	100-250	23-3	S, CR, HR, B, W	D	X	B[1]	181
182	Stainless Steel 441		Fe; Cr. 14-18; Ni. 2 max.; C. 0.15	186	235	6	S, P, CR, HR, B, W	D	X	B[1]	182
183	Stainless Steel 442		Fe; Cr. 18-23; C. 0.35 max.	55	80	35	S, P, CR, HR, B	A	X	B[1]	183
184	Stainless Steel 446		Fe; Cr. 23-30; C. 0.35 max.	50	80	23	S, P, CR, HR, B, W, T	A	X	B[1]	184
185	Stainless Steel 501		Fe; Cr. 4-6; C. 0.10	25	60	30	S, P, CR, HR, B, W, T	A	X	B[1]	185
186	Stainless Steel 502		Fe; Cr. 4-6; C. 0.10 max.	25	60	30	S, P, CR, HR, B, W, T	A	X	B[1]	186

*Yield strength is that load which will produce an elongation of .002" in 1". The value is obtained from stress-strain curves, and is based on a 25,000,000 psi. Modulus of Elasticity.

**Single figure (50) indicates minimum value; double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P = plates, S = sheets, CR = cold rolled, HR = hot rolled, B = bars, W = wire, T = tubing, R = rods.

‡‡Welding Qualities: A = Readily weldable, B = Weldable under favorable conditions (see footnotes), C = Not ordinarily weldable, D = No welding data available, X = This method of gas welding may be applied successfully to the chromium nickel and straight chromium alloys under certain conditions; but it is not as well adapted for general work with these alloys as is the metallic arc method. It is frequently employed on 20 gauge and lighter material.

a. Nickel Steel to A.S.T.M. Specs., b. Carbon Moly to A.S.T.M. Specs., c. Manganese Vanadium to A.S.T.M. Specs., d. Chrome Moly to U.S.Army or Navy Specs., e. Manganese Vanadium to U.S.Navy Specs., u. 1,650,000/T.S., v. 1,750,000/T.S., w. 1,500,000/T.S., x. 2,000,000/T.S.

1. Annealing suggested to remove brittleness and to improve ductility. 2. Post heat. 3. Unable to make ductile. 4. Preheat—cool slowly. 5. Pickled surface required. 6. Thin sections. 7. Heat treatment required. 8. Stress relieve after welding. 9. Impact strength increased by annealing. 10. Annealed. 11. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. Special welding technique required also. 12. Low preheat 100-300 F is desired or recommended during welding. 13. Low preheat 100-300 F is desired or recommended during welding in heavy sections. 14. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. 15. The necessity for stress relief annealing usually depends on the character of part and service. Adequate preheat can confer practically the same metallurgical advantages as part heating. 16. Can be flash welded. 17. Annealing necessary for maximum resistance to corrosion. 18. Use austenitic rod, e.g., 17 CR rod annealed.

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
187	SAE 2115	Lukens Steel Co., Coatesville, Pa.	S. .033; P. .015; C. .16; Mn. .53; Si. .23; Ni. 1.31	36	67	26	P	A	A	A	187
188	SAE 3140[10]	Lukens Steel Co., Coatesville, Pa.	S. .022; P. .014; C. .42; Mn. .73; Si. .25; Ni. 1.21; Cr. .73	71	115	22	P	B[11]	B[11]	B[11]	188
189	SAE 3340[10]	Lukens Steel Co., Coatesville, Pa.	S. .022; P. .014; C. .38; Mn. .73; Si. .23; Ni. 3.48; Cr. 1.49	80	143	15	P	C	C	D	189
190	SAE 4140	Lukens Steel Co., Coatesville, Pa.	S. .037; P. .016; C. .39; Mn. .76; Si. .23; Cr. 1.07; Mo. .19	62	115	17	P	B[11]	B[11]	D	190
191	SAE X 4130	Republic Steel Co., Massillon, Ohio	S. 0.05 max.; P. 0.04 max.; C. .25-.35; Mn. .40-.60; Cu. .80-1.10; Mo. .15-.25	100	125	18	S, P, B, W.	B[8]	B[8]	D	191
192	U.S.Army 57-136-8-c(d) U.S.Navy 47-S-14-b	U.S. Steel Corp., Pittsburgh, Pa.	S. .045 max.; P. .040 max.; C. .25-.35; Mn. .40-.60; Si. .15-.30; Cr. .80-1.10; Mo. .15-.25.	70	90	25-10	S, P, B.	B[15]	B[2]	D	192
193	U.S.Navy48-S-5Int.e(d)	U.S. Steel Corp., Pittsburgh, Pa.	S. .050 max.; P. .040 max.; C. .18 max.; Mn. 1.45 max.; Si. .25 max.; Ni. .25 max.; V. .08-.14.	50	90	22	S, P, HR, CR, B.	A	D	D	193
194	U.S.S. 17	U.S. Steel Corp., Pittsburgh, Pa.	S. .030 max.; P. .030 max.; C. .12 max.; Mn. .75 max.; Si. .75 max.; Ni. .50 max.; Cr. 14-18.	40-55	70-90	30-20	S, P, HR, CR.	B[18]	B[18]	D	194
195	U.S.S. 17-7	U.S. Steel Corp., Pittsburgh, Pa.	S. .030 max.; P. .030 max.; C. .09-.20; Mn. 2.00 max.; Si. .75 max.; Ni. 7-9; Cr. 16-18.	75-140	125-185	20-3	S.	B[17]	B[17]	A	195
196	U.S.S. 18-8	U.S. Steel Corp., Pittsburgh, Pa.	S. .030 max.; P. .030 max.; C. .08-.20; Mn. 2.00 max.; Si. .75 max.; Ni. 8-10; Cr 17.50-20.	30-45	80-95	60-50	S, P, HR, CR.	B[17]	B[17]	A	196
197	U.S.S. 18-8S.	U.S. Steel Corp., Pittsburgh, Pa.	S. .030 max.; P. .030 max.; C. .08 max.; Mn. 2.00 max.; Si. .75 max.; Ni. 8-10; Cr. 18-20.	30-45	80-95	60-50	S, P, HR, CR.	A[17]	A[17]	A	197
198	U.S.S. 18-8 Mo.	U.S. Steel Corp., Pittsburgh, Pa.	S. .030 max.; P. .030 max.; C. .10 max.; Mn. 2.00 max.; Si. .75 max.; Ni. 14 max.; Cr. 16-18; Mo. 2-3.	30-45	80-95	60-50	S, P, HR, CR.	B[17]	B[17]	D	198
199	U.S.S. 18-8 Ti.	U.S. Steel Corp., Pittsburgh, Pa.	S. .030 max.; P. .030 max.; C. .10 max.; Mn. 2.00 max.; Si. .75 max.; Ni. 7-10; Cr. 17-20; Ti. 4xC min.	30-45	80-95	60-50	S, P, HR, CR.	A	A	A	199
200	U.S.S. 18-8Cb	U.S. Steel Corp., Pittsburgh, Pa.	S. .030 max.; P. .030 max.; C. .10 max.; Mn. 2.00 max.; Si. .75 max.; Ni. 8-12; Cr. 17-12; Cb. 10xC min.	35-50	80-100	55-45	S, P, HR, CR.	A	A	A	200

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth.* 1,000 psi	Tensile Stgth.** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
201	U.S.S. 25-12.	U.S. Steel Corp., Pittsburgh, Pa.	S. .030 max.; P. .030 max.; C. .20 max.; Mn. 2.00 max.; Si. .75 max.; Ni. 12-14; Cr. 22-26.	40-50	90-110	50-35	S, P, HR, CR.	B[17]	B[17]	A	201
202	Yoloy .10% Carbon	Youngstown Sheet & Tube, Youngstown, Ohio	S. .05; P. .04; C. .08; Mn. .40; Ni. 1.70; Cu. 1.05	50	68	25	S, P, CR, HR, B, W	A	A	A	202
203	Yoloy .15% Carbon	Youngstown, Sheet & Tube, Youngstown, Ohio.	S. .05; P. .04; C. .15; Mn. .55; Si. .15; Ni. 1.70; Cu. 1.05	55	75	22	S, P, CR, HR, B, W	A	A	A	203
204	Yoloy .15% Carbon	Youngstown Sheet & Tube, Youngstown, Ohio.	S. .05; P. .04; C. .20; Mn. .65; Si. .15; Ni. 1.70; Cu. 1.05	58	80	20	S, P, CR, HR, B, W	A	A	A	204

*Yield strength is that load which will produce an elongation of .002" in 1". The value is obtained from stress-strain curves, and is based on a 25,000,000 psi. Modulus of Elasticity.

**Single figure (50) indicates minimum value; double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P = plates, S = sheets, CR = cold rolled, HR = hot rolled, B = bars, W = wire, T = tubing, R = rods.

‡Welding Qualities: A = Readily weldable, B = Weldable under favorable conditions (see footnotes), C = Not ordinarily weldable, D = No welding data available, X = This method of gas welding may be applied successfully to the chromium nickel and straight chromium alloys under certain conditions; but it is not as well adapted for general work with these alloys as is the metallic arc method. It is frequently employed on 20 gauge and lighter material.

a. Nickel Steel to A.S.T.M. Specs., b. Carbon Moly to A.S.T.M. Specs., c. Manganese Vanadium to A.S.T.M. Specs., d. Chrome Moly to U.S. Army or Navy Specs., e. Manganese Vanadium to U.S. Navy Specs., u. 1,650,000/T.S., v. 1,750,000/T.S., w. 1,500,000/T.S., x. 2,000,000/T.S.

1. Annealing suggested to remove brittleness and to improve ductility. 2. Post heat. 3. Unable to make ductile. 4. Preheat—cool slowly. 5. Pickled surface required. 6. Thin sections. 7. Heat treatment required. 8. Stress relieve after welding. 9. Impact strength increased by annealing. 10. Annealed. 11. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. Special welding technique required also. 12. Low preheat 100-300 F is desired or recommended during welding. 13. Low preheat 100-300 F is desired or recommended during welding in heavy sections. 14. Preheat during welding is required, the temperature during welding should be suitable for the composition and thickness of the material. 15. The necessity for stress relief annealing usually depends on the character of part and service. Adequate preheat can confer practically the same metallurgical advantages as part heating. 16. Can be flash welded. 17. Annealing necessary for maximum resistance to corrosion. 18. Use austenitic rod, e.g., 17 CR rod annealed.

This concludes the weldable ferrous alloys

On the pages to follow are listed the weldable non-ferrous alloys

WELDABLE ALLOY MATERIALS—NON-FERROUS

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
205	Admiralty	Revere Copper & Brass, Inc., New York	Zn. 28.; Pb. 0.075 max.; Sn. 1.0; Fe. 0.06 max.; Cu. 71.	16-20	40-50	65-55	S, P, HR, CR, B, W, T.	B[15]	B[16]	B[19]	205
206	Alcoa 2S-0	Aluminum Co. of America, Pittsburgh, Pa.	Al. 99.6	5	13	35	S, P, CR, HR, B, W, T, R.	A	A	A	206
207	Alcoa 2S-H	Aluminum Co. of America, Pittsburgh, Pa.	Al. 99.6	21	24	5	S, P, CR, HR, B, W, T, R.	A	A	A	207
208	Alcoa 3S-0	Aluminum Co. of America, Pittsburgh, Pa.	Mn. 1.2; Al. Rem.	6	16	30	S, P, CR, HR, B, W, T, R.	A	A	A	208
209	Alcoa 3S-H	Aluminum Co. of America, Pittsburgh, Pa.	Mn. 1.2; Al. Rem.	25	29	4	S, P, CR, HR, B, W, T, R.	A	A	A	209
210	Alcoa 17S-0	Aluminum Co. of America, Pittsburgh, Pa.	Cu. 4.0; Mn. 0.5; Mg. 0.5; Al. Rem.	10	26	20	S, P, CR, HR, B, W, T, R, F.	C	C	B[1]	210
211	Alcoa 17S-T	Aluminum Co. of America, Pittsburgh, Pa.	Cu. 4.0; Mn. 0.5; Mg. 0.5; Al. Rem.	40	62	20	S, P, CR, HR, B, W, T, R, F.	C	C	B[1]	211
212	Alcoa 24S-0	Aluminum Co. of America, Pittsburgh, Pa.	Cu. 4.6; Mn. 0.6; Mg. 1.5; Al. Rem.	10	26	20	S, P, CR, HR, B, W, T, R.	C	C	B[1]	212
213	Alcoa 24S-T	Aluminum Co. of America, Pittsburgh, Pa.	Cu. 4.6; Mn. 0.6; Mg. 1.5; Al. Rem.	45	68	19	S, P, CR, HR, B, W, T, R.	C	C	B[1]	213
214	Alcoa 24S-RT	Aluminum Co. of America, Pittsburgh, Pa.	Cu. 4.6; Mn. 0.6; Mg. 1.5; Al. Rem.	55	70	13	S, P, CR, HR, B, W, T, R.	C	C	B[1]	214
215	Alcoa 52S-0	Aluminum Co. of America, Pittsburgh, Pa.	Cr. 0.25; Mg. 2.5; Al. Rem.	14	29	25	S, P, CR, B, W, T, R.	A	A	A	215
216	Alcoa 52S-H	Aluminum Co. of America, Pittsburgh, Pa.	CR. 0.25; Mg. 2.5; Al. Rem.	36	41	7	S, P, CR, B, W, T, R.	A	A	A	216
217	Alcoa 53S-0	Aluminum Co. of America, Pittsburgh, Pa.	Si. 0.7; Cr. 0.25; Mg. 1.3; Al. Rem.	7	16	25	S, P , CR, HR, B, W, T, R, F	A	A	A	217
218	Alcoa 53S-W	Aluminum Co. of America, Pittsburgh, Pa.	Si. 0.7; Cr. 0.25; Mg. 1.3; Al. Rem.	20	33	22	S, P, CR, HR, B, W, T, R, F.	A	A	A	218
219	Alcoa 53S-T	Aluminum Co. of America, Pittsburgh, Pa.	Si. 0.7; Cr. 0.25; Mg. 1.3; Al. Rem.	33	39	14	S, P, CR, HR, B, W, T, R, F.	A	A	A	219
220	Alcoa 61S-0	Aluminum Co. of America, Pittsburgh, Pa.	Cu. 0.25; Si. 0.6; Cr. 0.25; Mg. 1.0; Al.Rem.	8	18	22	S, P, CR, HR, T.	A	A	A	220
221	Alcoa 61S-W	Aluminum Co. of America, Pittsburgh, Pa.	Cu. 0.25; Si. 0.6; Cr. 0.25; Mg. 1.0; Al. Remainder	21	35	22	S, P, CR, HR, T.	A	A	A	221
222	Alcoa 61S-T	Aluminum Co. of America, Pittsburgh, Pa.	Cu. 0.25; Si. 0.6; Cr. 0.25; Mg. 1.0; Al. Remainder	39	45	12	S, P, CR, HR, T.	A	A	A	222
223	Alclad 24S-T	Aluminum Co. of America, Pittsburgh, Pa.	Alcoa 24S-T with high-purity Al. coating	41	62	18	S, P.	C	C	A	223
224	Aluminum 2S-0	Sheet Aluminum Corp., Jackson, Mich.	Al. 99.6	5	13	35	S, P.	D	A	A	224
225	Aluminum 2S¼H	Sheet Aluminum Corp., Jackson. Mich,	Al. 99.6	13	15	12	S, P.	D	A	A	225
226	Aluminum 2S½H	Sheet Aluminum Corp., Jackson, Mich.	Al. 99.6	14	17	9	S, P.	D	A	A	226
227	Aluminum 2S¾H	Sheet Aluminum Corp., Jackson, Mich.	Al. 99.6	17	20	6	S, P.	D	A	A	227
228	Aluminum 2SH	Sheet Aluminum Corp., Jackson, Mich.	Al. 99.6	21	24	5	S, P.	D	A	A	228
229	Brass (70-30)	Revere Copper & Brass, Inc., New York	Zn. 30.; Pb. 0.05 max.; Fe. 0.05 max. Cu. 70.	13-17	40-50	55-45	S, P, HR, CR, B, W, T.	B[15]	B[16]	B[19]	229
230	Brass, High	Chase Brass & Copper Co., Inc. Waterbury, Conn.	Cu. 67; Zn. 33.	20	52	55	S, P, CR, B, W, T.	C	A	B[2]	230
231	Brass, Naval	(See Footnote ‡.)	Cu. 60; Zn. 39.25; Sn. 0.75.	30	55	40	S, P, CR, B.	B[15]	A	B[2]	231
232	Brass, Red	(See Footnote ‡.)	Cu. 85; Zn. 15.	14	42	47	S, P, CR, B, W, T.	B[2,15]	B[2,16]	C	232
233	Brass, Red, 85%	(See Footnote ‡.)	Cu. 85; Zn. 15;	15	40	45	S, P, CR, HR, B, W, T.	C	B[4]	C[3]	233
234	Brass, Yellow	American Brass Co., Waterbury, Conn.	Cu. 65; Zn. 35;	17	45	60	S, P, CR, HR, B, W.	C	B[11]	C	234
235	Bronze, Commercial	Revere Copper & Brass, Inc., New York	Zn. 10.; Pb. 0.03 max.; Fe. 0.05; Cu. 90	9-13	32-42	45-35	S, P, HR, CR, B, W, T.	B[15]	B[16]	C	235
236	Bronze, Roman	Revere Copper & Brass, Inc., New York	Zn. 39.25; Pb. 0.02 max.; Sn. 0.75; Fe. 0.05 max.; Cu. 60.	16-20	49-59	55-45	S, HR, CR, B, W, T.	B[15]	B[16]	B[19]	236
237	Deoxidized Copper	(See Footnote ‡.)	Cu. 99.9; P. 0.02;	10	33	35	S, P, CR, HR, B, W, T.	B[4,17]	B[4,18]	C	237

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth.* 1,000 psi	Tensile Stgth.** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
238	30% Cupro Nickel	(See Footnote ‡.)	Cu. 70; Ni. 30.	22	55	40	S, P, CR, HR, B, W, T.	A	A	A	238
239	Cupro Nickel 505	Revere Copper & Brass, Inc., New York	Pb. 0.05 max.; Fe. 0.5 max.; Cu. 80.; Ni. 20.; Mn. 0.75.	15-19	44-54	47-37	S, P, CR, B, W, T.	B[20]	B[21]	A	239
240	Dowmetal Ea	Dow Chemical Co., Midland, Mich.	Mn. 0.2; Al. 6.5; Mg. Remainder	20	39	15	S, P, CR.	B[5]	A	A	240
241	Dowmetal Eh	Dow Chemical Co., Midland, Mich.	Mn. 0.2; Al. 6.5; Mg. Remainder	34	45	9	S, P, CR.	B[5]	A	A	241
242	Dowmetal J-la	Dow Chemical Co., Midland, Mich.	Mn. 0.2; Al. 6.5; Zn. 1.0; Mg. Remainder	24	42	16	S, P, CR.	B[5]	B[6]	A	242
243	Dowmetal J-lh	Dow Chemical Co., Midland, Mich.	Mn. 0.2; Al. 6.5; Zn. 1.0; Mg. Remainder	35	45	8	S, P, CR.	B[5]	B[6]	A	243
244	Dowmetal Ma	Dow Chemical Co., Midland, Mich.	Mn. 1.5; Mg. Remainder	16	32	15	S, P, CR.	B[5]	A	A	244
245	Dowmetal Mh	Dow Chemical Co., Midland, Mich.	Mn. 1.5; Mg. Remainder	27	37	9	S, P, CR.	B[5]	A	A	245
246	Everdur 1010	American Brass Co., Waterbury, Conn.	Cu. 95.8; Mn. 1.1; Si. 3.1;	20	55	60	S, P, CR, HR, B, W, F.	A	A	A	246
247	Herculoy 418	Revere Copper & Brass, Inc., New York.	Si. 3.0; Pb. 0.02 max.; Sn. 0.5; Fe. 0.10 max.; Cu. Rem.	22-26	55-65	70-60	S, P, HR, CR, B, W, T.	B[22]	B[23]	B[24]	247
248	Herculoy 419	Revere Copper & Brass, Inc., New York.	Si. 1.75; Pb. 0.02 max.; Sn. 0.25; Fe. 0.10 max.; Cu. Rem.	20-24	40-50	70-60	S, P, HR, CR, B, W, T.	B[22]	B[23]	B[24]	248
249	Herculoy 420	Revere Copper & Brass, Inc., New York	Mn. 1.0; Si. 3.0; Pb. 0.02 max.; Fe. 0.10 max.; Cu. Rem.	22-26	55-65	70-60	S, P, HR, CR, B, W, T	B[22]	B[23]	B[24]	249
250	Herculoy 421	Revere Copper & Brass, Inc., New York	Mn. 0.3; Si. 1.75; Pb. 0.02 max.; Fe. 0.10 max.; Cu. Rem.	20-24	40-50	70-60	S, P, HR, CR, B, W, T.	B[22]	B[23]	B[24]	250
251	Hyblum AAO	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.12; Si. 0.45; Ni. 0.70; Cu. 0.23	11	20	25	S, P.	D	A	A	251
252	Hyblum AA¼H	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.12; Si. 0.45; Ni. 0.70; Cu. 0.23	22	24	6.5	S, P.	D	A	A	252
253	Hyblum AA½H	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.12; Si. 0.45; Ni. 0.70; Cu. 0.23	25	26	4	S, P.	D	A	A	253
254	Hyblum AA¾H	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.12; Si. 0.45; Ni. 0.70; Cu. 0.23;	27	28	3	S, P.	D	A	A	254
255	Hyblum AAH	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.12; Si. 0.45; Ni. 0.70; Cu. 0.23	32	33	3	S, P.	D	A	A	255
256	Hyblum BO	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.05; Si. 0.45; Ni. 0.30; Cu. 0.10	8.6	16	25	S, P.	D	A	A	256
257	Hyblum B¼H	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.05; Si. 0.45; Ni. 0.30; Cu. 0.10	17	21	9	S, P.	D	A	A	257
258	Hyblum B½H	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.05; Si. 0.45; Ni. 0.30; Cu. 0.10	20	22	5	S, P.	D	A	A	258
259	Hyblum B¾H	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.05; Si. 0.45; Ni. 0.30; Cu. 0.10	23	25	3	S, P.	D	A	A	259
260	Hyblum BH	Sheet Aluminum Corp., Jackson, Mich,	Mn. 0.05; Si. 0.45; Ni. 0.30; Cu. 0.10	26	27	2	S, P.	D	A	A	260

*Yield strength is that load which will produce an elongation of .002″ in 1″. The value is obtained from stress-strain curves, and is based on a 25,000,000 lbs. in/² Modulus of Elasticity. **Single figure (50) indicates minimum value, double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P=plates, S=sheets, CR=cold rolled, HR=hot rolled, B=bars, W=wire, T=tubing, R=rods. ‡‡Welding Qualities: A=readily weldable, B=weldable under favorable conditions (see footnotes), C=not ordinarily weldable, D=no welding data available, E=welding in experimental stage.

‡Available from American Brass Co., Chase Brass and Copper Co., and Revere Copper and Brass, Inc.

1. Mild corrosion conditions only. 2. Consult producer. 3. A special high silicon red brass having an "A" rating for resistance spot and seam welding is available. 4 . High heat required. 5. Weldable in a Helium atmosphere. 6. Limited to simple structures. 7. Preheating. 8. Comparatively short seams only. 9. Applies to spot welding. Seam welding is also satisfactory but as yet in little commercial use. 10. Butt welding is limited to comparatively simple shape. 11. Oxidizing flame. 12. Carbon or coated metal arc. 13. Must reheat treat. 14. Limited to comparatively thin sections. 15. Carbon Arc: Play on zinc free filler rod of silicon or phosphor bronze types; 700-1000 F. preheat desirable for heavier gauges. 16. Slightly oxidizing flame desirable with filler rods or strips of base metal composition, or with "bronze" welding rods. 17. Metallic Arc: Coated electrode and 700-900 F. preheat. Carbon Arc: Silicon or phosphor bronze filler rods and 500-900 F. preheat. 18. Adequate preheat and deoxidized filler rod. 19. Accurate control over pressure, time and heat necessary. 20. Coated cupro-nickel electrodes. 21. Usually employed for thinner gauges; reducing flame necessary to prevent formation of refractory nickel oxide; flux recommended. 22. Carbon Arc: Silicon bronze filler rods; flux necessary; arc length and manipulation of carbon electrode both important. 23. Slightly oxidizing flame recommended; flux necessary; "hot shortness" of alloys necessitates care to prevent cracking of "closed structure" type welds. 24. Surface must be free of silicon oxide; accurate control over variables necessary. 25. Metallic Arc: Coated electrodes; preheat necessary in medium and heavy thicknesses. Carbon Arc: Phosphor bronze filler rods arc length important—long arc preferred.

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
261	Hyblum DO18	Sheet Aluminum Corp., Jackson, Mich.	Mn. 0.16; Si. 0.45; Ni. 1.00; Cu. 0.32; Mg. 0.40	37	43	12	S, P.	D	A	A	261
262	Illium "R" (Annealed)	Burgess-Parr Company, Freeport, Illinois	C. 0.2 max.; Mn. 1-2; Si. 0.65 max.; Ni. 55-58; Cr. 22-24; Cu. 3-7; Mo. 5-7; Fe. 5-7	45-55	95-105	30-45	S, P, CR, HR, B, W. T. R	A	B[7]	A	262
263	Illium "R" (Work Hardened)	Burgess-Parr Company, Freeport, Illinois	C. 0.2 max.; Mn. 1-2; Si. 0.65 max.; Ni. 55-58; Cr. 22-24; Cu. 3-7; Mo. 5-7; Fe. 5-7	60-100	105-150	12-3	S, P, CR, HR, B, W. T. R	A	B[7]	A	263
264	Inconel	International Nickel Co., Inc., New York.	S. 0.015; C. 0.08; Mn. 0.25; Si. 0.25; Ni. 79.5; Cr. 13.0; Cu. 0.2; Fe. 6.5	30-45	80-100	50-35	S, P, CR, HR, B, W, T.	A	A	A	264
265	Inconel Clad Steel	Lukens Steel Co., Coatesville, Pa.	Ni. 79.5; Cr. 13; Fe. 6.5; Mn. 0.25; Si. 0.25; C. .08; Cu. .20	30	55	30	S, P, HR.	A	C	B[14]	265
266	Mazlo AM35	American Magnesium Corp., Cleveland, O.	Mn. 1.5; Mg. Remainder	17-27	32-36	16-5	S, P, CR, HR, B, W, T.	E	A	A[9, 10]	266
267	Mazlo AM52S	American Magnesium Corp., Cleveland, O.	Mn. 0.2; Al. 3.0; Zn. 1.0; Mg. Remainder	25-34	38-46	18-10	S, P, CR, HR, B, W, T.	E	A	A[9, 10]	267
268	Mazlo AM-C52S	American Magnesium Corp., Cleveland, O.	Mn. 0.2; Al. 3.0; Zn. 1.0; Mg. Remainder	25-34	38-46	18-10	S, P, CR, HR, B, T.	E	A	A[9, 10]	268
269	Mazlo AM-C57S	American Magnesium Corp., Cleveland, O.	Mn. 0.2; Al. 7.2; Zn. 1.2; Mg. Remainder	26-35	42-50	10-6	S, P, CR, HR, B, T, F.	E	B[8]	A[9, 10]	269
270	Manganese Bronze	American Brass Company, Waterbury, Conn.	Cu. 59.; Zn. 39.0; Sn. 0.70; Mn. 0.50; Fe. 0.80	30	60	30	S, P, CR, HR, B.	C	B[11]	C	270
271	Monel	International Nickel Co. New York, N. Y.	S. 0.01; C. 0.15; Mn. 1.0; Si. 0.1; Ni. 67.0; Cu. 30.0; Fe. 1.4	25-90	65-110	50-20	S, P, CR, HR, B, W, C, T, R	A	A	A	271
272	Monel Clad Steel	Lukens Steel Co., Coatesville, Pa.	Ni. 67.; Cu. 30.; Fe. 1.4; Mn. 1.0; C. 0.15; Si. 0.1	30	55	30	S, P, HR.	A	C	B[11]	272
273	Muntz Metal	Revere Copper & Brass, Inc., New York	Zn. 40.; Pb. 0.30 max.; Fe. 0.07 max.; Cu. 60.	13-17	52-62	53-43	S, P, HR, CR, B, W, T.	B[15]	B[16]	B[19]	273
274	Nickel	International Nickel Co., New York, N. Y.	S.005; C. 0.1; Mn. 0.2; Si. 0.05; Ni. 99.4; Cu. 0.1; Fe. 0.15	15-75	60-100	50-30	S, P, CR, HR, B, W, C, T, R.	A	A	A	274
275	Nickel Clad Steel	Lukens Steel Co., Coatesville, Pa.	Ni. 99.4; C. 0.1; Cu. 0.1; Fe. 0.15; Mn. 0.2; Si. 0.05	30	55	30	S, P, HR.	A	C	B[14]	275
276	Olympic Bronze, Type A	Chase Brass & Copper Co., Inc., Waterbury, Conn.	Si. 3.0; Cu. 96.0; Zn. 1.0;	20	55	65	S, P, CR, B, W, T.	A	A	A	276
277	Olympic Bronze, Type B	Chase Brass & Copper Co., Waterbury, Conn.	Si. 1.5; Cu. 97.5; Zn. 1.0;	16	45	40	S, W, T.	A	A	A	277
278	Phosphor Bronze "A"	Revere Copper & Brass, Inc., New York	P. 0.2; Pb. 0.05 max.; Sn. 5.; Fe. 0.05 max.; Cu. 95.	18-22	45-55	60-50	S, P, CR, B, W.	B[25]	C	A	278
279	5% Phosphor Bronze	American Brass Co., Waterbury, Conn.	Cu. 95.0; Sn. 5.0;	20	48	50	S, P, CR, HR, B, W.	B[12]	C	B	279
280	Pure Clad 17ST	Reynolds Metals Co., Louisville, Ky.	Reynolds 17ST, high purity Al. coating	33	56	18	S, P,.	D	C	A	280
281	Pure Clad 24ST	Reynolds Metals Co., Louisville, Ky.	Reynolds 24ST, high purity Al. coating	41	62	18	S, P.	D	C	A	281
282	Reynolds 2SO	Reynolds Metals Co., Louisville, Ky.	Al. 99.0 (Min)	5	13	35	S, P, CR, HR, B, W.	D	A	A	282
283	Reynolds 2S¼H	Reynolds Metals Co., Louisville, Ky.	Al. 99.0 (Min)	13	15	12	S, P.	D	A	A	283
284	Reynolds 2S½H	Reynolds Metals Co., Louisville, Ky.	Al. 99.0	14	17	9	S, P.	D	A	A	284
285	Reynolds 2S¾H	Reynolds Metals Co., Louisville, Ky.	Al. 99.0	17	20	6	S, P.	D	A	A	285
286	Reynolds 2SH	Reynolds Metals Co., Louisville, Ky.	Al. 99.0	21	24	5	S, P.	D	A	A	286

No.	Material	Manufacturer	Nominal Chemical Composition (Percent)	Yield Stgth. * 1,000 psi	Tensile Stgth. ** 1,000 psi	Elongation % in 2 in.	Forms Available†	Welding Qualities‡‡			No.
								Arc	Gas	Resistance	
287	Reynolds 3SO	Reynolds Metals Co., Louisville, Ky.	Mn. 1.2; Al. Remainder	6	16	30	S, P, CR, HR, B, W.	D	A	A	287
288	Reynolds 3S¼H	Reynolds Metals Co., Louisville, Ky.	Mn. 1.2; Al. Remainder	15	18	10	S, P.	D	A	A	288
289	Reynolds 3S½H	Reynolds Metals Co., Louisville, Ky.	Mn. 1.2; Al. Remainder	18	21	8	S, P.	D	A	A	289
290	Reynolds 3S¾H	Reynolds Metals Co., Louisville, Ky.	Mn. 1.2; Al. Remainder	21	25	5	S, P,	D	A	A	290
291	Reynolds 3SH	Reynolds Metals Co., Louisville, Ky.	Mn. 1.2; Al. Remainder	25	29	4	S, P.	D	A	A	291
302	Reynolds 17SO	Reynolds Metals Co., Louisville, Ky.	Cu. 4.0; Mg. 0.5; Mn. 0.5; Al. Remainder	10	26	20	S, P, CR, HR, B, W.	D	B[13]	C	302
303	Reynolds 17ST	Reynolds Metals Co., Louisville, Ky.	Cu. 4.0; Mg. 0.5; Mn. 0.5; Al. Remainder	40	62	20	S, P, CR, HR, B, W.	D	B[13]	C	303
304	Reynolds 24SO	Reynolds Metals Co., Louisville, Ky.	Cu. 4.5; Mg. 1.5; Mn. 0.6; Al. Remainder	10	26	20	S, P.	D	B[13]	C	304
305	Reynolds 24ST	Reynolds Metals Co., Louisville, Ky.	Cu. 4.5; Mg. 1.5; Mn. 0.6; Al. Remainder	45	68	19	S, P.	D	B[13]	C	305
306	Reynolds 52SO	Reynolds Metals Co., Louisville, Ky.	Mg. 2.5; Cr. 0.25; Al. Remainder	14	29	25	S, P, CR, HR, B, W.	D	A	A	306
307	Reynolds 52S¼H	Reynolds Metals Co., Louisville, Ky.	Mg, 2.5; Cr. 0.25; Al. Remainder	26	34	12	S, P.	D	A	A	307
308	Reynolds 52S½H	Reynolds Metals Co., Louisville, Ky.	Mg. 2.5; Cr. 0.25; Al. Remainder	29	37	10	S, P.	D	A	A	308
309	Reynolds 52S¾H	Reynolds Metals Co., Louisville, Ky.	Mg. 2.5; Cr. 0.25; Al. Remainder	34	39	8	S, P.	D	A	A	309
310	Reynolds 52SH	Reynolds Metals Co., Louisville, Ky.	Mg. 2.5; Cr. 0.25; Al. Remainder	36	41	7	S, P.	D	A	A	310
311	Reynolds 53SO	Reynolds Metals Co., Louisville, Ky.	Mg. 1.3; Si. 0.7; Cr. 0.25; Al. Remainder	7	16	25	S, P, CR, HR, B, W.	D	D	D	311
312	Reynolds 53SW	Reynolds Metals Co., Louisville, Ky.	Mg. 1.3; Si. 0.7; Cr. 0.25; Al. Remainder	20	33	22	S, P, CR, HR, B, W.	D	D	D	312
313	Reynolds 53ST	Reynolds Metals Co., Louisville, Ky.	Mg. 1.3; Si. 0.7; Cr. 0.25; Al. Remainder	33	39	14	S, P, CR, HR, B, W.	D	D	D	313
314	Reynolds 61SO	Reynolds Metals Co., Louisville, Ky.	Cu. 0.25; Mg. 1.0; Si. 0.6; Cr. 0.25; Al. Remainder	8	18	22	S, P, CR, HR, B, W.	D	D	D	314
315	Reynolds 61SW	Reynolds Metals Co., Louisville, Ky.	Cu. 0.25; Mg. 1.0; Si. 0.6; Cr. 0.25; Al. Remainder	21	35	22	S, P, CR, HR, B, W.	D	D	D	315
316	Reynolds 61ST	Reynolds Metals Co., Louisville, Ky.	Cu. 0.25; Mg. 1.0; Si. 0.6; Cr. 0.25; Al. Remainder	39	45	12	S, P, CR, HR, B, W.	D	D	D	316
317	Super Nickel Clad Steel	Lukens Steel Co., Coatesville, Pa.		30	55	30	S, P, HR.	A	C	B[14]	317
318	Tobin Bronze	American Brass Co., Waterbury, Conn.	Cu. 60.0; Zn. 39.25; Sn. 0.75;	22	56	45	S, P, CR, HR, B, W. R.	C	B[11]	C	318

*Yield strength is that load which will produce an elongation of .002″ in 1″. The value is obtained from stress-strain curves, and is based on a 25,000,000 lbs. in/² Modulus of Elasticity. **Single figure (50) indicates minimum value, double figures (28-50) indicate range which varies because of production processes or other causes, e.g., heat treatment, annealing, cold rolling, drawing, etc.

†Available forms: P = plates, S = sheets, CR = cold rolled, HR = hot rolled, B = bars, W = wire, T = tubing, R = rods. ‡‡Welding Qualities: A = readily weldable, B = weldable under favorable conditions (see footnotes), C = not ordinarily weldable, D = no welding data available, E = welding in experimental stage.

‡Available from American Brass Co., Chase Brass and Copper Co., and Revere Copper and Brass, Inc.

1. Mild corrosion conditions only. 2. Consult producer. 3. A special high silicon red brass having an "A" rating for resistance spot and seam welding is available. 4. High heat required. 5. Weldable in a Helium atmosphere. 6. Limited to simple structures. 7. Preheating. 8. Comparatively short seams only. 9. Applies to spot welding. Seam Welding is also satisfactory but as yet in little commercial use. 10. Butt welding is limited to comparatively simple shape. 11. Oxidizing flame. 12. Carbon or coated metal arc. 13. Must reheat treat. 14. Limited to comparatively thin sections. 15. Carbon Arc: Play on zinc free filler rod of silicon or phosphor bronze types; 700-1000 F. preheat desirable for heavier gauges. 16. Slightly oxidizing flame desirable with filler rods or strips of base metal composition, or with "bronze" welding rods. 17. Metallic Arc: Coated electrode and 700-900 F. preheat. Carbon Arc: Silicon or phosphor bronze filler rods and 500-900 F. preheat. 18. Adequate preheat and deoxidized filler rod. 19. Accurate control over pressure, time and heat necessary. 20. Coated cupro-nickel electrodes. 21. Usually employed for thinner gauges; reducing flame necessary to prevent formation of refractory nickel oxide; flux recommended. 22. Carbon Arc: Silicon bronze filler rods; flux necessary; arc length and manipulation of carbon electrode both important. 23. Slightly oxidizing flame recommended; flux necessary; "hot shortness" of alloys necessitates care to prevent cracking of "closed structure" type welds. 24. Surface must be free of silicon oxide; accurate control over variables necessary. 25. Metallic Arc: Coated electrodes; preheat necessary in medium and heavy thicknesses. Carbon Arc: Phosphor bronze filler rods arc length important—long arc preferred.

ACKNOWLEDGMENT. The Welding Engineer wishes to thank the various companies whose names appear as a part of this survey, for the information and courtesies extended to its Editors in the collecting of this material. All information on the chemical, mechanical and welding properties are made on the authority of the manufacturers to whom questionnaires were submitted.

REPRINTS AVAILABLE. "Weldable Alloy Materials," another of The Welding Engineer's Reports to the welding industry. Copies will be available in reprint form bound in paper covers at $1.00 each. Requests for reprints should be addressed to The Welding Engineer Publishing Company, 506 South Wabash Ave., Chicago, Ill.

The Technical Slant

The man who doesn't read good books has no advantage over one who can't read them.

Aviation

AEROSPHERE *1941. Edited by Glenn* D. ANGLE. *Published by Aircraft Publications, New York. 1941. Cloth, 8½x11 in., 948 pages. Price $10.00.*

Aerosphere 1941 is the second edition of this popular guide to the aircraft industry. As the name implies, this publication covers the more important spheres in the field of aviation and brings up-to-date the advances made in aeronautics in the two years which have elapsed since the first edition was published.

Aerosphere 1941 is divided into four sections; the first of these is devoted to modern aircraft. In this section all known current types of aircraft, both commercial and military, produced throughout the world are described and illustrated. Specifications, performance data, and similar information is given.

The second section is called Modern Aircraft Engines. In it, in condensed form, is given all the available information on aircraft engines, their specifications, performance data, construction and equipment details. This material covers all aircraft engines in current production throughout the world. There is also included information on some experimental jobs as well as engines of new design.

Statistics, covering aircraft records, CAA personnel and statistics and airmail information, are compiled in the 112 pages of the third section.

The final 308 pages, the fourth section, is a Buyer's Guide in which producers of aircraft and aircraft equipment are listed, alphabetically, by product and geographically.

To those interested in aeronautics, they will find in Aerosphere 1941 a complete and convenient reference book of the industry.

» «

Blueprint Reading

MACHINE TRADES BLUEPRINT READING. *By Russel W. Ihne and Walter E. Streeter. Published by American Technical Society, Chicago, 1941. Paper, spiral bound, 8½x11 in., 140 pages. Price $2.00.*

Aided by actual blueprints and practical problems on shop mathematics and blueprint reading, Machine Trades Blueprint Reading presents in a practical style a worthwhile training program on a most important phase of shop work.

The book opens with a glossary of shop terms, simple shop mathematics, and then takes the reader into the basic information which must be learned to interpret a blueprint. After having learned to read prints dealing with the principles of projection and standards of drawing practice, the reader is presented with problems arising from actual prints in use in industry.

To be sure the reader is obtaining the greatest possible benefits from his study, there are present a number of problems and questions covering the pertinent points of each print under discussion.

» «

Machine Shop

NEW ENCYCLOPEDIA OF MACHINE SHOP PRACTICE. *Edited by George W. Barnwell. Published by Wm. H. Wise & Co., Inc. New York, 1941. Cloth, 5½x8½ in., 548 pages. Price $1.98.*

In the fourteen chapters of this book the work of ten authors have been combined to compile what might better be considered a "Handbook of Machine Shop Practice" rather than an encyclopedia.

This 548 page book, with an average of over one illustration to the page, covers all phases of machine shop practice. The opening chapter is on bench work while the final chapter in nine pages quite skimpily, discusses machine drawing; those chapters between these two give pointers on the tools and the uses of most machine tools used in shop practice.

Since this review is for a welding magazine it must be said that, since only 17 pages could be devoted to welding, it is regrettable that the welding section could not have been written by one more conversant with the subject. The welding text, what little there is, contains several contradictory statements and others which if not in error, are at least doubtful. One such statement warrants quoting "Admittedly, welding skill, as such, is little more than an abilty to direct the weld metal where it is needed without letting slag be trapped underneath when it solidifies."

The final 36 pages of the book are devoted to useful tables of information which is of interest to machine shop employees.

» «

Machine Tools

DRILLING AND GRINDING. *Edited by E. Malloy. Published by Chemical Publishing Co., Inc., Brooklyn, N. Y., 1941. Cloth, 5½x8½ in., 104 pages. Price $2.00.*

Drilling and grinding is the eighth volume in the "Complete Engineer" series, and is designed to serve as a text and reference for those engaged in production work involving these two tools.

The book opens with a very important chapter which explains, simply, the basic principles of reading micrometers and vernier calipers. This is followed by a chapter on drilling. In it are discussed: The various types of drills; speeds; feeds; drill grinding; and the various drilling machines.

In the third chapter, grinding, grinding machines, and various types of abrasives are discussed; while the fourth and final chapter of the book is devoted to centreless grinding. Special attention has been devoted to the selection of grinding wheels and the fixing of grinding speeds.

The subject matter of the text is supplemented by 92 line drawings and halftones.

» «

Shipbuilding

PRACTICAL SHIP PRODUCTION, SECOND EDITION. *By A. W. Carmichael. Published by McGraw-Hill Book Co., Inc., New York, 1941. Cloth, 6x9 in., 283 pages. Price $3.00.*

In the 22 years which have elapsed since the publication of the first edition of Practical Ship Production, many changes have taken place in the methods of building ships. The most notable of these is the use of arc welding and because of it most of this book has been written.

Practical Ship Production, in many respects, might be considered as a shipyard handbook, at least it is an excellent reference book for those engaged in shipbuilding. The opening chapter deals with the various fundamentals which must be considered in the design of ships. After discussing these requirements of ships, the reader is told of the general description of ships, structural members of ships and the design of ships.

The author now takes you into the shipyard to discuss the yard; tools; personnel and management. The final 80 pages (two chapters) tell of the preliminary details of shipbuilding and actual ship constructions. So that the readers knowledge might be unbiased, three types of construction are discussed, namely, welded, riveted and welded and riveted.

This is the most complete and authoritative book on welded ship construction to come to this reviewer's attention and it is highly recommended to those desiring to learn more of this important industry.

» «

Success does not come so much from sitting up nights, as it does from staying awake in the daytime.

» «

If you get what you want, you are successful; if you want what you get you are happy.

» «

What a fine world this would develop to be, if we did as well today as we expect to do tomorrow.

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Resistance Welding and National Defense

The many uses of resistance welding in National Defense includes the seam welding of anti-aircraft shell and the spot welding of shell transporting cases.

By
BARCLAY J. TODDSWORTH

All of the welding processes are recognized as playing an important part in our present day program of defense production. Often, however, the name of one process becomes so closely associated with a particular industry that its use in equally important defense production is overlooked. Such has been the case with resistance welding.

Whenever resistance welding is mentioned, as a tool of defense production, the immediate thought of its important uses in the construction of military aircraft. The swing to metal airplanes with their thousands of rivets naturally led the aircraft industry to seek faster, easier and less expensive ways of aircraft fabrication.

The spot welder proved to be a tool which met these three requirements. It was faster, easier and less expensive because it eliminated the use of rivets, the drilling of rivet holes and the slow and tedious job of riveting the structure. When the spot welded airplanes were completed and tested, it was found that spot welding had done other things for the aircraft manufacturers as well. Not only had spot welding reduced manufacturing costs and speeded production but it had also produced a finished product which had improved appearance and performance characteristics.

The all-metal airplane which had been fabricated by spot welding had sleek, smooth surfaces unblemished by the heads of thousands of rivets. The eliminating of these countless rivet heads also eliminated the additional pounds of resistance those heads offered. Thus the additional h.p. which had been required to pull rivet heads through the air were now released to improve the performance of the airplane. As a result, it was found that both top speed and the cruising speed of the spot welded plane were from 5 to 8% faster than those of the plane of the same design fabricated by riveted construction.

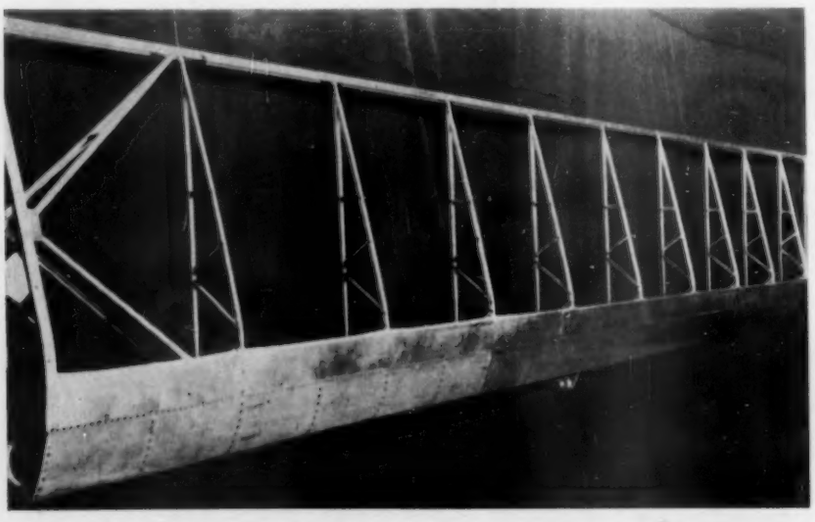

Fig. 1—A spot welded stainless steel aileron for a military airplane.

While spot welding has not replaced rivets in all aircraft construction, it has greatly reduced the number of rivets used in building many of the present day military airplanes. In one of the large bombers now in this country's armed services, about one-third of the rivets have been replaced by spot welding, or, of the 750,000 possible points for welding, 250,000 are now being joined by welding processes.

This is indeed a remarkable gain for welding in one phase of defense production, especially when it is considered that most of the present day military airplanes are of aluminum construction. Aluminum, the metal of low electrical resistance and high heat conductivity, the successful spot

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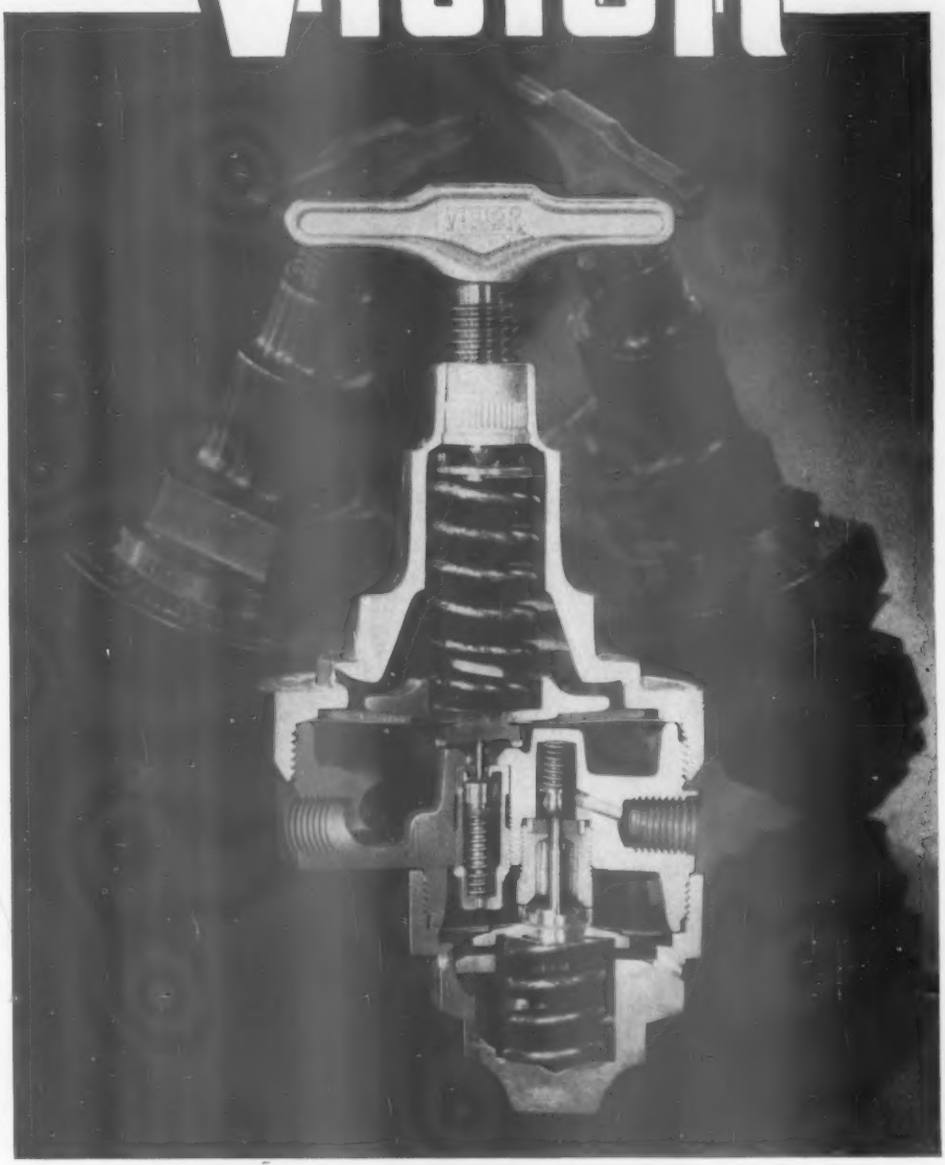

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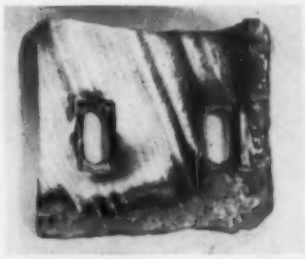

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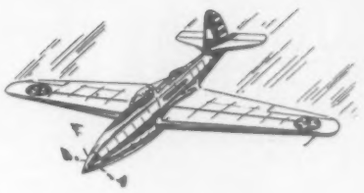


welding of which has been a remarkable accomplishment for the resistance welding industry.

But, as was stated before, the aircraft industry is not the only place that resistance welding is being used in our national defense program. It is only that its work in the aircraft industry has been most publicized. Resistance welding in its various forms, such as spot, seam, flash and butt welding, is doing an equally as important job in the manufacture of munitions.

Welding of Shells

Since most resistance welding machines are of special design, there has been designed a special seam welder for use in the production of 75 mm. and 3 in. anti-aircraft shells. The specifications in this instance call for attaching a .031 in. thick circular disc of bright, soft annealed steel to the bases of the anti-aircraft shell cases. The machine had to be adjustable so as to take care of 2.26 in. diameter disc for the 75 mm. shells and a 2.50 in. disc for the 3 in. shells and the welds were required to be gas tight.

While it has been said this welder was of special design, it should also be said that it is of standard design in many respects and the fixture lends itself as is, or with some modifications, to a great many other applications. The resistance welder unit in this case was a standard 40 KVA transformer with 16 points of heat regulation. The driving power for rotating the shell holding chuck is supplied by half h.p., 1200 r.p.m. motor. A closeup of this unit in operation may be seen in Fig. 3.

The two seam welding wheels are mounted on long, vertical slides and are backed by adjustable pressure springs. The ram supporting the slides is raised and lowered by a 4 in. bowler adjustable strock air cylinder. The wheel electrodes are also adjustable to and away from each other to allow for the variation in size of the disc for the 75 mm. and the slightly larger 3 in. anti-aircraft shells. Each wheel is connected to the secondary terminal of the transformer so that the current passes from one wheel through the disc and the shell and into the other wheel. By this arrangement the entire secondary current is contained in the head of the machine. Sufficient cooling water is obtained by mention of hollow water cooling shaft welding wheels and through the encasement of the welding wheel barges in water troughs. The primary circuit is controlled by a tube contactor and is interrupted to produce approximately 60 individual welds around the outer edge of the disc.

Much of the success of this unit is the ingenious two station sliding feature which makes it possible to keep the machine in almost constant operation and which also relieves the operator of practically all responsibility for accuracy in the location of the work or the lining of the disc in the shell casings. Each station consists of a quick acting hand operated chuck designed to grip the body of the shell and a spring backed cup located at the bottom of the chuck which centers the castings on its nose end.

In the making of the weld, the operator puts a shell casing in each chuck, places a disc in position on the base of each casing, brings the welding wheel into position over one of the stations, by stepping on a foot valve and starts the shell rotating by pressing a push button switch. The welding current is applied automatically and is cut off as soon as the shell turns 180 degrees, rotation of the shell is also stopped automatically.

High Speed Production

Upon the completion of the first weld, the operator shifts the station by means of a hand lever and starts the second welding cycle. While the second shell is being welded, the first station is unloaded and re-loaded and the procedure repeated continuously with a high degree of efficiency. With such a set-up, it is possible for one operator to weld a shell in 12 seconds or, at 100% efficiency, at a rate of 300 an hour. Using two operators, the time required for welding these discs and shell casings can be reduced to 9 seconds or again at 100% efficiency the production is increased to 400 shells per hour.

A study of Table I gives a breakdown of the production figures and shows how the assigning of an operator to each of the two stations greatly increases the output of the machine. These production figures are based on an average welding speed of 5½ to 6 fpm. Larger shell disc or slower welding speeds would naturally change the time required for welding.

After the shells have been welded, they are sent to a shell loading plant

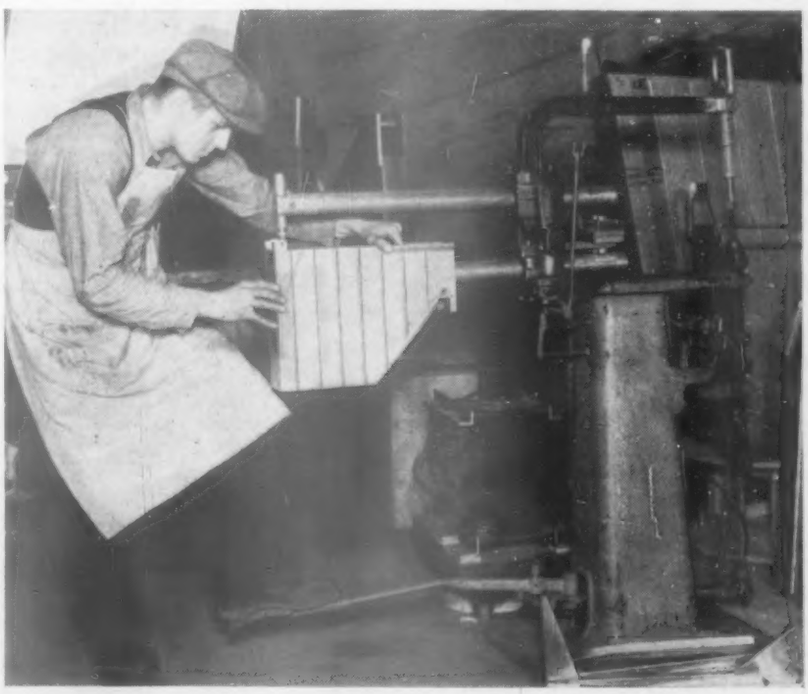


Fig. 2—Spot welding of stainless steel for ammunition boxes at the Curtiss Aircraft plant.

Table I—Approximate Production for Welding 75mm. Anti-Aircraft Shells.

WITH ONE OPERATOR		WITH TWO OPERATORS	
Rotate Shell (3 sec.), Load and Unload Shell at Other Station. Total	6.0 Sec.	Loading Station: Load and Unload	6.0 Sec.
Lift Head	1.0 Sec.	Welding Station: Place Disc	2.0 Sec.
Shift Fixture	1.5 Sec.	Lower Head and Start Rotation	1.5 Sec.
Place Disc	2.0 Sec.	Rotate	3.0 Sec.
Lower Head and Start Rotation	1.5 Sec.	Lift Head	1.0 Sec.
	12.0 Sec.		7.5 Sec.
		Shift Stations	1.5 Sec.
			9.0 Sec.
or 300 Shells/hr. at 100% Efficiency or 240 Shells/hr. at 80% Efficiency		or 400 Shells/hr. at 100% Efficiency or 320 Shells/hr. at 80% Efficiency	

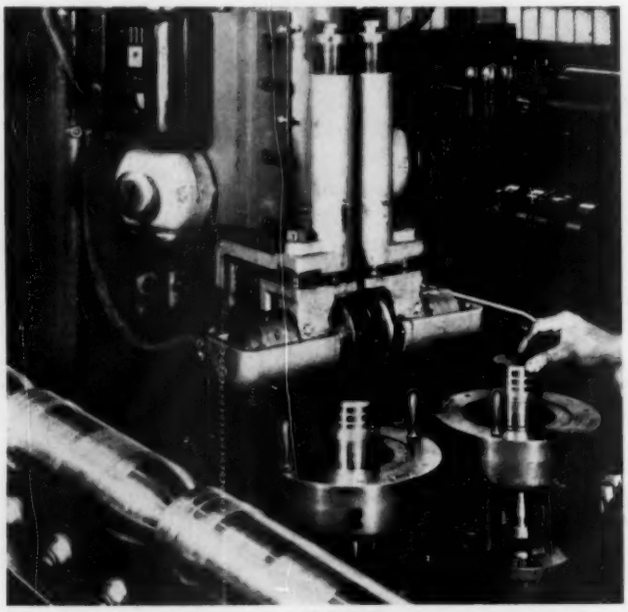


Fig. 3—Resistance seam welding disc in anti-aircraft shells.

for loading and are then placed in a shipping case for transportation to the munitions dump and later to the eventual point of use where the shell is fired—sent on its way to complete its destructive purpose. In the construction of these transportation cases, spot welding is playing an important part. As metal has replaced wood, so has spot welding replaced nails and screws.

Again a special spot welder has been designed to do a job but as in most such designs, the welding unit, power assembly and guns are of standard design with only the fixture and the base of special construction. The welder, Fig. 4, is equipped with a power clamping fixture to facilitate the loading and unloading.

The shipping case is fabricated as follows: The parts for the case are dropped over and into the locating fixture which also forms one of the electrodes. A lever is pulled down and plates come against the work under power, clamping the part securely in the fixture against the entire electrode. A 24 gun welding unit then moves in against the work and the welding cycle is started. On the completion of the welding, the parts move away from the work and the clamps are retracted by reversing a lever and assembled case is removed.

Assembly specifications call for close tolerances for these 25 lb. shell transporting cases. They must hold the shell securely even though the cases are stacked during transportation. Despite these requirements 180 complete cases are made each hour. With 24 welds per case, a total of 4320 welds per hour are made to demonstrate the production possibilities of resistance welding.

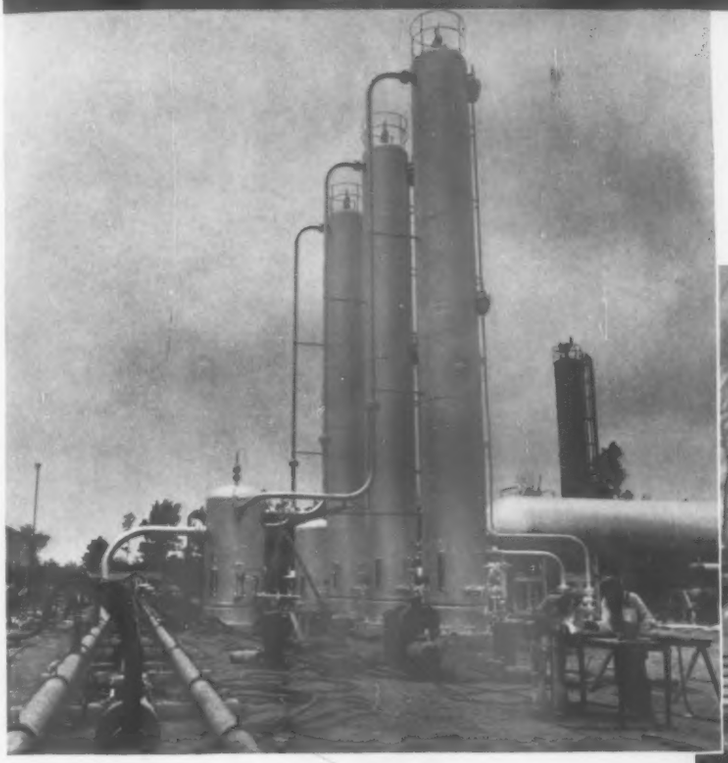
There are many other examples of the important work that resistance welding is doing in connection with this country's armament and defense efforts. The examples cited, however, have been selected only to show that the resistance welding manufacturers are continually seeking to do the job better and to make production easier for those manufacturers faced with the acute production demands of emergency armament orders.

The illustrations in this article are credited as follows; Fig. 1, Fleetwings, Inc.; Fig. 2, U. S. Army Air Corps; Fig. 3, Thomson Gibbs Electric Welder Co., and Fig. 4, Progressive Welder Co.

Fig. 4—Shell transport cases of steel and spot welds instead of wood and nails.

COTTON VALLEY

Pierce Governors do their bit on big national defense project!



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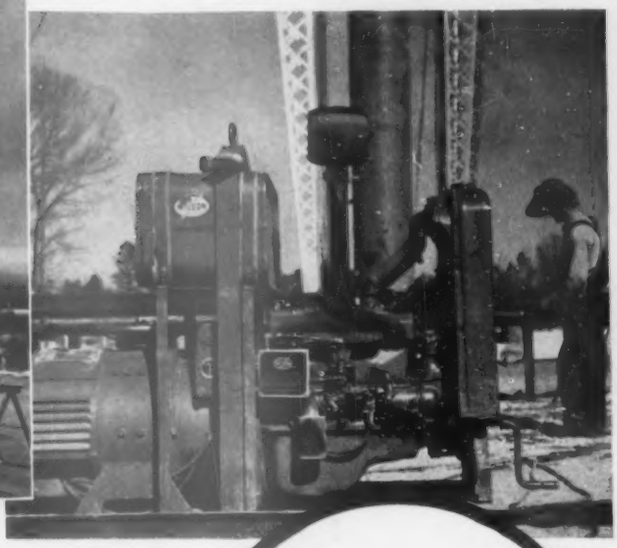

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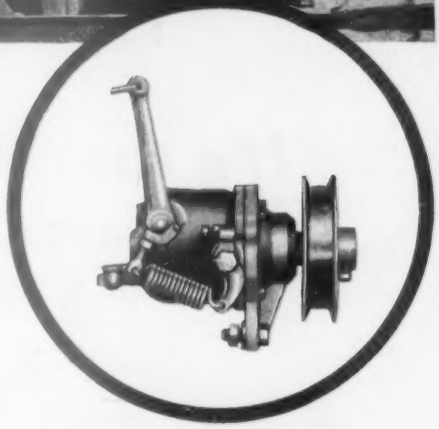

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20. Cutting Attachments—70° or 90° Heads—operate on LOW or MEDIUM PRESSURE Acetylene, Propane, Butane, Natural or City Gas.
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New Product Developments of 1941

A review of the New Products announced in The Welding Engineer *since the Metal Show of 1940.**

A-C Welder

G. E. 500 amp. A.C. Arc Welder. Transformer type which incorporates power factor correction. Large, easily read current indicator; protected output terminals; and fan-forced ventilation. The General Electric Co., Schenectady, N. Y. **Oct. 1940.**

» «

Greyhound. A 300 amp. continuous duty A-C arc welder with 28 heat stages. Greyhound Electric Mfg. Co., Inc., Brooklyn, N. Y. **Oct. 1940.**

» «

General Electric. A 300 amp. A-C welding transformer built in power correction factor. General Electric Co., Schenectady, N. Y. **Nov. 1940.**

» «

G-R Model 85 Multi-Purpose Arc Welder. A 2, 3, or 4 operator multiple circuit unit machine having range from 90 to 625 amps. or a single operator unit with a range of 100 to 2,000 amps. Glenn-Roberts Co., Inc., Oakland, Cal. **March 1941.**

» «

Eisler. An A-C transformer type arc welder in 100 to 400 amp. capacity for operations on 220 volt 60 cycle A-C current. May also be obtained for 440 or 550 volts. Eisler Engineering Co., Newark, N. J. **May 1941.**

» «

Ideal A-C Arc Welder. A transformer type welder featuring 15 different welding heats between 20 and 175 amps. Ideal Commutator Dresser Co., Sycamore, Ill. **May 1941.**

» «

Greyhound 500 amp. A 500 amp. transformer type A-C welder for heavy duty protection work. Greyhound Electric Mfg. Co., Brooklyn, N. Y. **May 1941.**

» «

Midget Marvel WT-1. A small transformer type portable A-C welder having a welding current ranging from 20 to 140 amps. in 15 steps. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. **August 1941.**

» «

Miller A-C Welder. A transformer type A-C welder in four different sizes, 3, 4, 5 and 600 amp. capacities. Miller Electric Mfg. Co., Appleton, Wis. **August 1941.**

Wilson A-C Welder Model W-T. Transformer type A-C welder of 3, 5, 750 to 1000 amp. capacities. Suitable for use on 200, 400, or 550 volts. 25 to 60 cycle current. Wilson Welder & Metals Co., New York, N. Y. **Sept. 1941.**

» «

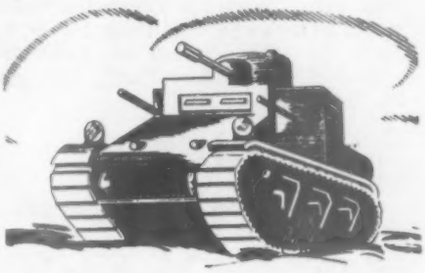
Acetylene Generator

Oxweld PM-10. Acetylene generator capable of delivering 30 cu. ft. of acetylene per hour. Linde Air Products Co., New York, N. Y. **July 1941.**

» «

Arc Torch

Carbon Arc Torch. A carbon arc torch for A-C welders with adjustable tips capable of handling carbons from ¼ to ½ in. in diameter. Albert & J. M. Anderson Mfg. Co., Boston, Mass. **Feb. 1941.**



Wiese Arc Torch. An arc torch suitable for A-C or D-C welding using ⅜" or smaller size carbon electrodes. Wiese Plow Welding Co., Perry, Iowa. **April 1941.**

» «

Atomic Hydrogen Welder

General Electric. Improved design in atomic hydrogen welders of 35 to 75 amp. capacity. General Electric Co., Schenectady, N. Y. **June 1941.**

» «

Brazing Process

Tempobrazing. A patented process for hard soldering of seams with the use of a resistance welder. Thomson-Gibb Electric Welding Co., Lynn, Mass. **August 1941.**

» «

Brazing Unit

Ideal Electric Brazer. A transformer unit and electric heating pliers for brazing and soldering with silver solder. Ideal Commutator Dresser Co., Sycamore, Ill. **August 1941.**

Brush Concaver

Ideal Brush Concaver. A template for attaching to electric grill or grinder for concaving ring or commutator brushes. Suitable for practically any size commutator from 4 to 48 in. in diameter. Ideal Commutator Dresser Co., Sycamore, Ill. **Dec. 1940.**

» «

Cable Connectors

Jackson Cable Connectors. Insulated connectors of positive grip type suitable for various sizes of electric arc welding cables from No. 1 to 4/0. Jackson Products, Detroit, Mich. **Nov. 1940.**

» «

Circuit Breaker

Westinghouse M1 and M2. A new low cost multiple breaker unit for use on any normal duty application which would otherwise require fuses or fuse switches. Available in 15 to 100 amps. sizes. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa. **August 1941.**

» «

Contactor

Weltronic Model 108-53. A timer contactor for any 15 to 35 C.A. manually or mechanically timed spot welder. Weltronic Corp., Detroit, Mich. **Jan. 1941.**

» «

Weld-O-Trol WS 150. An electric welding contactor readily adapted for use with heat control and either synchronous welding timers including sequence equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. **August 1941.**

» «

Contacts

Metroloy. Tungsten electrical contact points made from highly fused pure tungsten metal. The Metroloy Co., Inc., Newark, N. J. **Oct. 1940.**

» «

Crane Switch

Cleveland air operated switch. An air operated switch for use on cab operated gravity operated switch for overhead handling systems. Cleveland Tramrail Div., Wickliffe, Ohio. **April 1941.**

» «

Crater Eliminator

Stroco Electric Arc Crater Eliminator. A control for use on D-C welders to eliminate weld craters. Wilson Welder & Metals Co., New York, N. Y. **August 1941.**

*For more complete information on a particular product kindly refer to the issue dated in bold face type with each item.

New Product Developments of 1941

Cutting Attachment

Rego KXA Cutting Attachment. A new cutting attachment suitable for use with all Rego Series welding torch handles. Available with 75 or 90 deg. head. National Cylinder Gas Co., Chicago, Ill. **July 1941.**

» «

Cutting Tips

Rego KXW Rivet Washing Tips. Low velocity cutting tips for use in washing off rivet heads, frozen nuts, removing minor defects in castings and hand or machine gouging. National Cylinder Gas Co., Chicago, Ill. **July 1941.**

» «

Cutting Torch

Airco Style 33180 and 9080. 21 in. stainless steel and monel cutting torches for use in removing rises from metal castings. May be used with any number of a new series of tips known as Style 187, 181 and 191. Air Reduction Sales Co., New York, N. Y. **April 1941.**

» «

Gasweld Model 30-P and 301-P. Manually operated cutting torches of button lever type valve control for use with propane, butane and all liquefied petroleum gases. Gasweld Equipment Co., Chicago, Ill. **Feb. 1941.**

» «

Cutting Machines

Oxweld CM-35 Bar Cutting Machine. Hydraulic controlled cutting torch which may be clamped on bars. Cutting speed ranges from 1 to 75 in. per minute. The cutting range of standard equipment from 2 to 10 inches. By special linkage arrangement, the range can be increased to 8 to 15 in. Linde Air Products Co., New York, N. Y. **Oct. 1940.**

» «

Cylinder Truck

Oxweld T-7 Two Wheel Welding Truck. A lightweight rubber tired truck designed to carry an oxygen and acetylene cylinder and complete welding and cutting outfit. Linde Air Products Co., New York, N. Y. **April 1941.**

» «

Cylinder Valving Machine

Universal Valving Machine Model A-2. A machine for inserting and removing valves from compressed gas cylinders ranging in diameter from 2 to 16 in. and from 10 to 53 in. in height. Independent Engineering So., O'Fallon, Ill. **Feb. 1941.**

» «

D-C Welders

SA200 Junior. A 200 amp. engine driven D-C welder. **SA200.** A 200 amp. motor generator type D-C welder. The Lincoln Electric Co., Cleveland, Ohio. **Oct. 1940.**

Aircraft Special. Motor-generator type D-C arc welder with welding range from 15 to 125 amp. or 100 amp. continuous service. The Hobart Brothers Co., Troy, Ohio. **Oct. 1940**

» «

G.E. 250 amp. Welder. A D-C welder with current range of 25 to 250 amp. using electrodes from ⅛ to ⅜ in. diameter. General Electric Co., Schenectady, N. Y. **Oct. 1940.**

» «

Streamline Junior—Model GR-202-S. Gas engine driven 200 amp. electric arc welder. The Hobart Brothers Co., Troy, Ohio. **Oct. 1940.**

» «

Lincoln Aircraft Welder. A welder available in two models, 150 and 200 amps. size. Either portable or stationary. Current range from 150 amp. model to 10 to 200 amps. and for the 200 amp. model, the range is 10 to 250 amps. Lincoln Electric Co., Cleveland, Ohio. **July 1941.**

» «

Demagnetizer Unit

Magnaflux. Type SB demagnetizer with D.C. Magnaflux inspection units, available with openings from 5x7 in. to 28x14 in. Also manual or automatic operation. Magnaflux Corp., Chicago, Ill. **Oct. 1940.**

» «

Dial Gauge

GS Dial Test Indicator. A dial gauge graduated in thousandths of an inch with a plunger travel of ⅜ in. George Scherr Co., New York, N. Y. **Feb. 1941.**

» «

Drafting Machine

Master-Drafto Model No. 60. A lightweight drafting machine for a maximum size sheet of 24 x 36 in. Drafte Co., Cochranton, Pa. **Feb. 1941.**

» «

Drawing and Cutting Oils

Wayne No. 4 Aluminum Drawing Oil. A viscous for use in deep drawing of thin aluminum sheets.

Wayne No. 2 Aluminum Cutting Oil. A very thin oil for use in machining. Wayne Chemical Co., Detroit, Mich. **July 1941.**

» «

Drum Tipper

Lewis-Shepard Drum Tipper. Device consisting of handle and prong collar for tipping drums and barrels. Lewis-Shepard Sales Corp., Watertown, Mass. **Jan. 1941.**

» «

Electric Drill

B & D ¼ in. Standard Electric Drill. An electric drill capable of drilling up to ¼ in. in steel and a ½ in. in hardwood. Standard speed, 2000 r.p.m. Also available in speeds from 3500 to 500 r.p.m. Black & Decker Mfg. Co., Towson, Md. **April 1941.**

» «

Electric Polishers

Stanley No. 182 and No. 187 Polisher. Two low speed (600 r.p.m.) polishers fitted with universal motors. Designed for cleaning and polishing of metal, removal of stains and heat tints caused by welding. Stanley Electric Tool Div., New Britain, Conn. **March 1941.**

» «

Electric Polisher Brush

Osborn No. 2588-S-2. An 8¼ in. dia. by ½ in. wide. This dense brush is recommended for use with Stanley polishers. Osborn Mfg. Co., Cleveland, Ohio. **March 1941.**

» «

Electric Polishing Materials

New Steel Cleaner and Polish. A polish designed for cleaning and polishing metal and removing the stains or heat tints caused by welding. Pynosal Laboratories, Inc., Chicago, Ill. **March 1941.**

» «

Electric Sanders

Stanley Sander No. 72 and No. 92. These are Universal driven sanders and cut grinders suitable for smooth welds and surfaces where considerable metal is to be removed. Sander No. 72 swings a 7 in. disc at 4200 r.p.m. while No. 92 will handle a 9 in. disc at a speed of 300 r.p.m. Stanley Electric Tool Div., New Britain, Conn. **March 1941.**

» «

Electrode Holders

Duro Electrode Holders. Duro Holder No. 500 is designed for heavy duty and will remain cool at 500 amp. in addition to giving long life; Duro Holder No. 400 (plain) and No. 400 (I) (fully insulated) are companion holders to Duro Holder No. 500. Churchward Engineering Co., New Haven, Conn. **Oct. 1940.**

» «

Electrode Holder

U. S. Holder. An electrode holder of conventional design featuring many outstanding claimed advantages. U.S. Electric Welder Corp., Toledo, Ohio. **Sept. 1941.**

» «

Erection

Saxe Welded Connection. A seat for use in the erection of welded steel structures. Consists of an erection seat and an erection clip adaptable to any assembly where structural steel parts must be located and held for welding. J. H. Williams & Co., Buffalo, N. Y. **Oct. 1940.**

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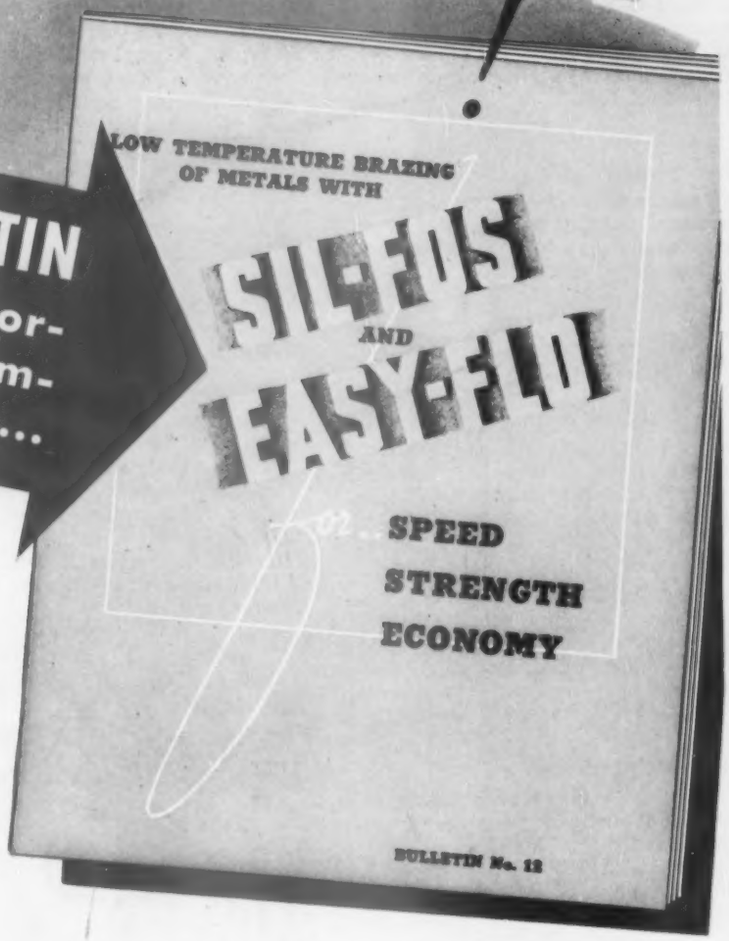

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New Product Developments of 1941

Electronic Welder

Weld-O-Tron. A low current electronic welder having a range from 5 to 40 amps., using $\frac{1}{32}$" to $\frac{3}{64}$" electrodes. Allis-Chalmers Mfg. Co., Milwaukee, Wis. **Feb. 1941.**

» «

Eye Shield

Jackson Type BX. Eye shield using standard welding lens for use in welding, cutting, and blow torch operations. Jackson Products, Detroit, Mich. **Feb. 1941.**

» «

Face Shield

Sellstrom Depend-On. Plastic safety shield covering the entire face. Designed for chipping, grinding and similar designs to afford protection during similar operations. Sellstrom Mfg. Co., Chicago, Ill. **May 1941.**

» «

B & C Face Shield, Model 66. A plastacele window gimp bound face shield for chipping and grinding operations. Boyer-Campbell Co., Detroit, Mich. **Feb. 1941.**

» «

Fire Extinguisher

Pyrene G-1 Fire Extinguishing Powder. An extinguishing powder for use in putting out magnesium fires in industry and incendiary bombs. Pyrene Mfg. Co., New York, N. Y. **July 1941.**

» «

Fire Extinguisher Seal

Pyrene Gardeseal. A plastic seal to use on fire extinguishers to indicate whether they have been tampered with or used. Fire Extinguisher Mfg. Co., Newark, N. J. **April 1941.**

» «

Flashlight Cell

Triumph. A flashlight cell containing electrolyte in glass bulb. Electrolyte designed for long storage life before use. Triumph, Elkton, Md. **June 1941.**

» «

Flash Welder

Federal Type F-4. Available with transformer capacities up to 150 kva., suitable for welding stock up to 1 sq. in. welding area. Also suitable for rounds, flats or formed sections. Federal Machine and Welder Co., Warren, Ohio. **Oct. 1940.**

» «

Galvanizing Compound

Galvalloy. A galvanizing powder to be brushed on weld seams of galvanized items. Galen F. Biery, Seattle, Wash. **August 1941.**

Gas Economizer

Rego Economizer, Model 4360. Instant shut off valve arrangement for lightweight torches. Designed to operate on unbalanced pressures as extreme as 3 ounces acetylene pressure to 50 lbs. of oxygen pressure. National Cylinder Gas Co., Chicago, Ill. **May 1941.**

» «

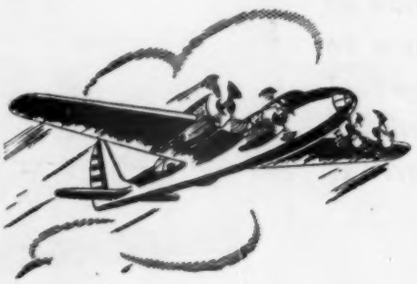
Gas Regulator

Rego No. 2503 LP Gas Regulator. A gas regulator for liquid petroleum industry. Designed primarily for heavy load conditions. Bastian-Blessing Co., Chicago, Ill. **July 1941.**

» «

Gas Valves

RegO 2580 and 2581 Gas Valves. Especially designed liquefied petroleum valves for permanent installation on ICC cylinders and ASME or API—ASME above ground containers. Bastian-Blessing Co., Chicago, Ill. **August 1941.**



Gauge Tester

M.S.A. Velocity Power Gauge Tester. A device designed for safety gauges used in conjunction with compressed gas storage cylinders to determine their ability to withstand sudden applications of surge pressure. Mine Safety Appliance Co., Pittsburgh, Pa. **Jan. 1941.**

» «

Goggles

Metro Bakelite 50 mm. Goggle. Goggle of bakelite construction for welding and chipping operations. Acetylene & Oxygen Supply Co., Inc., Long Island City, N. Y. **Oct. 1940.**

» «

On-Center Safety Goggle. Safety Goggle for use in chipping and grinding operations. American Optical Co., Southbridge, Mass. **May 1941.**

» «

G-E Type GL-415. A water cooled tube which when working in paris is capable of controlling 265 kva resistance welding loads on 5½ duty cycle. Also suitable for air cooling at reduced rating. General Electric Co., Schenectady, N. Y. **April 1941.**

Goggle Lens

Tulca Safety Goggle Lens. A nonshatterable lens especially designed for use in flash welding operations. Univis Lens Corp., Dayton, Ohio. **Jan. 1941.**

» «

Neophan. A welding lens of special design for use in the welding of aluminum and other materials emitting yellow light rays. Fish-Schurman Corp., New York, N. Y. **July 1941.**

» «

Grinder Shields

Stanley Flud-Lite Eye Shield. Safety glass window eye shields fitted with bayonet type light bulbs for use on all belt or motor driven grinders. The Stanley Electric Tool Div., New Britain, Conn. **May 1941.**

» «

Ground Clamp

Mueller No. 33 Big Brute. Spring clip type welding clamp with jaw spread of 2 in. Designed for 300 amp. service. Mueller Electric Co., Cleveland, Ohio. **May 1941.**

» «

Hard-Facing Material

Colmonoy No. 6. This hard-facing is applied to a steel base by a furnace bonding process in which no additional bonding material is required. Wall-Colmonoy Corp., Detroit, Mich. **Oct. 1940.**

» «

Hydraulic Press

Elmes Hydraulic Press. Hydraulic press for general shop work, varying capacities powered by 1½ H. P. motor. Charles F. Elmes Engineering Co., Chicago, Ill., **Jan. 1941.**

» «

Ignitron Rectifier

Westinghouse Ignition Rectifier. Especially designed rectifier available in 2 capacities, 40 kva or 120 kva for supplying DC current to magnetic storage type spot welders. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa. **April 1941.**

» «

Ignitron Tubes

Ignitron Tubes. Tubes for resistance welder control of stainless steel jacket and corrosion resistant qualities. General Electric Company, Schenectady, N. Y. **Feb. 1941.**

» «

Arc-Ban. Lightweight welding goggle offered in two models to take care of those workmen with corrective spectacles and also those whose eyes require no correction. Bausch & Lomb, Rochester, N. Y. **June 1941.**

There's the STAINLESS STEEL WELDING ELECTRODE YOU WANT"

● It's listed on page 6 of this booklet on Stainless Steel Welding and Electrodes that has been prepared by PAGE.

●

You probably know as well as we do that you must look for and insist on getting two distinctly different *kinds* of quality in your Stainless Steel Electrodes.

It is imperative for good Stainless Steel Welding that the deposit *in the weld* be equal to the Stainless Steel you are welding.

It is just as important that the electrode be of the shield-arc type, to protect the metal in the weld; equally usable in horizontal, vertical and overhead positions; permit high speed welding with minimum spatter and slag loss and smooth beads.

To get all those qualities for you, PAGE worked in the field and laboratory with the world's largest producers of Stainless Steel —until they said every PAGE Stainless Electrode was *right*.

Start right, then, with your Stainless welding. Depend on PAGE. Tell your local PAGE Distributor the Stainless Steel you want to weld and accept his recommendation.

Be sure to ask your local PAGE Distributor for a copy of this valuable, well illustrated booklet on the welding of Stainless Steels. It covers the entire subject.

PAGE WELDING ELECTRODES

PAGE STEEL AND WIRE DIVISION • MONESSEN, PENNSYLVANIA

AMERICAN CHAIN & CABLE COMPANY, Inc.

New Product Developments of 1941

Inspection Unit

Portable Inspection Unit, Type KQ-1. Magnaflux unit adapted for the inspection of welds. Type KQ-1 operates on 220-440 volts, 3 phase, 60 cycle A.C. and Type KQ-04 delivers up to a maximum of 400 amp. D.C. The Magnaflux Corp., Chicago, Ill. **Oct. 1940.**

» «

Low Temperature Alloy

Weldoloy. Low temperature brazing alloys for use with steel, aluminum, bronze and brass. Tensile strength range between 23,000 and 115,000 psi. Melting point varies from 360 to 1600 depth. Weldoloy Mfg. Co., New York, N. Y. **March 1941.**

» «

Castolin Low Temperature Alloys. Synthetic alloy rods and fluxes in different analyses for the low temperature brazing of various types of parent metal. Eutectic Welding Alloys, Inc., New York, N. Y. **March 1941.**

» «

Lubricant

Dri-Lube. A silver colored powder lubricant said to replace graphite in uses where smut or dirt are objectionable. Wayne Chemical Co., Detroit, Mich. **August 1941.**

» «

Metallizing Gun

Metco Metallizing Gun Type 2E. A metal spray gun weighing 4¾ lbs. suitable for use with acetylene, propane, hydrogen natural or manufactured gas. Maximum air pressure required, 65 psi. Metallizing Engineering Co., Long Island City, N. Y. **April 1941.**

» «

Motor

G-E Tri-Clad. A polyphase intregal h.p. motor for streamlined appearance for industrial operation. General Electric Co., Schenectady, N. Y. **Dec. 1940.**

» «

Non-Magnetic Steel

Manganel. A non-magnetic steel containing 11 to 13½ manganese and 3½% nickel. Joseph T. Ryerson & Son, Inc., Chicago, Ill. **Oct. 1940.**

» «

Perspiration Retainer

M.S.A. Coolband. A soft flexible band which encircles the head. Designed to keep head perspiration from getting into the eyes when wearing goggles and glasses. Mine Safety Appliance Co., Pittsburgh, Pa. **June 1941.**

» «

Power Plugs and Sockets

Jones Series 500 Power Plugs. Plugs and sockets designed for 5000 volts and 25 amps. with from 2 to 12 contacts. Howard B. Jones, Chicago, Ill. **Jan. 1941.**

Power Unit

Simpac. A self-contained A.C. generating unit. Ratings from 3.75 kva. to 187 kva. are available voltages of 120/208, 240 to 480, with operating speeds from 600 to 1800 rpm. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa. **Oct. 1940.**

» «

Pressure Gauge

G-E Electrode Pressure Gauge. A pressure gauge for use in checking pressures on spot, line and projection welding electrodes. Capacity to 400 lbs. psi. General Electric Co., Schenectady, N. Y. **August 1941.**

» «

Pressure Meter

Thomson-Gibb Resistance Welding Pressure Meter. A pressure meter for use in changing pressure on resistance welding electrodes. Available in 8 models, ranging from 0 to 300 lb. and from 0 to 8,000 lbs. Thomson-Gibb Electric Welding Co., Lynn, Mass. **Jan. 1941.**

» «

Protractor

Trumark Junior. A protractor for marking layouts at any angle on rods or pipe up to 3 in. in diameter for rectangular sheet metal channels or flat surfaces. Trumark Corp., Los Angeles, Cal. **Jan. 1941.**

» «

Regulator

Two-Stage Regulator. Designed to assure even back pressure at all times. Made to fit any model Sight Feed Generator. The Sight Feed Generator Co., Richmond, Ind. **Oct. 1940.**

» «

Renewal Flints

Giant Size Renewal Flint. An oversized heavy duty renewal flint for spark lighters. Flint Products Co., Brooklyn, N. Y. **Jan. 1941.**

» «

Resistance Welding Electrode

Mallory 22 Metal. Recommended for use on stainless steel, terneplate and other coated metals or for hydromatic welding machines and applications where water cooling is impractical. P. R. Mallory & Co., Inc., Indianapolis, Ind. **Oct. 1940.**

» «

Resistance Welding Timer

Weltronic Model 52. An electric timer for automatic timing for requirements where sequence must be controlled to the fraction of a second. Weltronic Corp., Detroit, Mich. **Feb. 1941.**

» «

Electronic Timer Type T 15. A universal interval timer with range of from 1/20th of a second to 2 minutes, 1000 watt capacity. Photoswitch, Inc., Cambridge, Mass. **Oct. 1940.**

» «

Weltronic Model 75. A timer featuring adjustment by means of control knobs operating cycles range from 2 to 30 cycles. Available in any commercial voltage and frequency. Weltronic Corp., Detroit, Mich. **March 1941.**

» «

Weltronic Model No. 114. A semi-automatic electronic impulse timer.

Weltronic Model No. 57 high speed automatic timer for use in spot welding applications. Both feature dial adustment. Weltronic Corp., Detroit, Mich. **July 1941.**

» «

Resistors

Ohmite. Wound wire vitreous enamel resistors available in live or dead bracket tips for special application. Core dia. range from ⅜ to 2½ in. Ohmite Mfg. Co., Chicago, Ill. **May 1941.**

» «

Respirator

M.S.A. Comfo Metal Fume Respirator. A respirator bearing Bureau of Mines approval for protection against metal fumes produced when cutting or welding galvanized iron. Mine Safety Appliance Co., Pittsburgh, Pa. **Nov. 1940.**

» «

Shears

Quickwork 62-A. A rotary shear designed for cutting up to 2 in. mild steel plate. Quickwork-Whiting Div., The Whiting Corp., Harvey, Ill. **Jan. 1941.**

» «

Solder Flux

Superior Silver Solder Flux No. 6. A concentrated paste flux for silver soldering of ferrous and non-ferrous metals. Silver Solder Flux Co., Cleveland, Ohio. **Nov. 1940.**

» «

Tru Flux Soldering Syrup. Soldering syrup in full strength or diluted solutions flux for use with most metals. American Chemical Process Co., Long Island City, N. Y. **Feb. 1941.**

» «

Spatter Preventive

Spatter-Off. A water-soluble material to prevent spatter from adhering to welded parts adjacent to weld areas. Universal Power Corp., Cleveland, Ohio. **Jan. 1941.**

» «

Anti-spatter. A material for use on pickled or non-pickled work to prevent weld spatter from adhering. Thompson & Co., Pittsburgh, Pa. **Sept. 1941.**

Now More Important Than Ever!

NORTON SERVICE

Local Stocks

In over 150 cities Norton distributors have grinding wheels on their shelves—service of stock wheels for the defense industries. Backing the distributor stocks are Norton branch warehouses in five industrial centers. Back of them are the immense stock rooms at Worcester and a factory organization geared to meet abnormal needs.

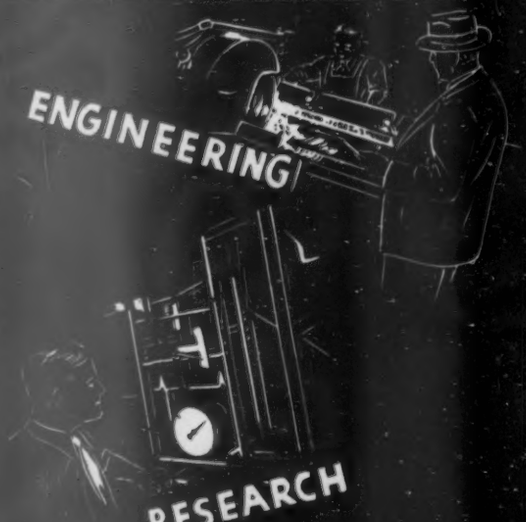
Field Staff

Over 1800 distributors' representatives, coöperating with Norton field engineers and factory specialists, are ready to give you engineering service—can be especially helpful on your many grinding problems as you change from the production of regular products to defense products. A wealth of data on grinding in the defense industries has been compiled at Worcester—sent in by the field men everywhere for mutual use.

Trained Scientists

When some new defense product or material brings an entirely new grinding problem the Norton research laboratories are ready to help find the answer. A staff of over 50 trained scientists and technicians is constantly at work in well equipped laboratories that occupy over 45,000 square feet of floor space.

NORTON COMPANY, WORCESTER, MASS.



NORTON ABRASIVES

New Product Developments of 1941

Spot Welders

Hot Spot Type 2. Foot operated, rocker arm type spot welders of 20 to 50 kva capacities. Acme Electric Welder Co., Huntington Park, Cal. **Oct. 1940.**

Eisler No. 250-AA. A long-horn spot welder. Available in 5 to 75 kva units with horn lengths varying from 30 to 40 inches. Eisler Engineering Co., Newark, N. J. **Oct. 1940.**

» «

Acme Spot Welder. Air operated arm spot welders in capacities from 10 kva. to 75 kva., available with 6 to 48 steps of heat regulations. Acme Electric Welder Co., Huntington Park, Cal. **Nov. 1940.**

» «

Acme Spot Welder. Press type spot and projection welders in varying capacities from 30 to 150 kva. with horn length varying from 12 to 48 in. Acme Electric Welder Corp., Huntington Park, Cal. **Jan. 1941.**

» «

Eisler Multiple Spot Welder. A spot-welder designed primarily for use in light sheet metal work, capable of welding 2 to 12 spots simultaneously. Eisler Engineering Co., Newark, N. J. **April 1941.**

» «

Universal Model J Spot Welder. A bench-type of spot welder in capacities varying from 2½ to 7½ kva and floor types with capacities from 2½ to 5 kva in the rocker arm type of construction. Universal Power Corp., Cleveland, Ohio. **July 1941.**

» «

Progressive Deep Throat Welder. Deep throat welder available in standard capacities of 75 to 150 kva. Progressive Welder Co., Detroit, Mich. **Sept. 1941.**

» «

Spot Welding Control

Condens-O-Weld. A new capacitor discharge resistance welding control for welding aluminums and alloys such as are used in the aircraft industry. Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. **July 1941.**

» «

Terminal Strips

Jones Barrier Terminal Strips. Compact terminal strips for inner connections of electrical circuits in industrial equipment. Howard B. Jones, Chicago, Ill. **July 1941.**

» «

Torches

Forster Torch Line. Torches designed especially for use with propane and butane for heating, soldering, painting brushes, etc. The Bastian-Blessing Co., Chicago. Ill. **Jan. 1941.**

Welder Control

Lincoln Type G. Dual control unit for use on Lincoln A-C and D-C welders. Lincoln Electric Co., Cleveland, Ohio. **Sept. 1941.**

» «

Welder Conversion Unit

Rex Butt welding attachment. A unit suitable for converting any rocker arm type spot welder into a butt welder by the removing and replacing of the horns with a new unit. Dyer Welder and Engineering Co., Kansas City, Mo. **August 1941.**

» «

Welding Electrodes

Amsco Mo-Mang. A welding electrode in 18 in. length coated for both A-C and D-C applications. American Manganese Steel Div. of American Brake Shoe & Foundry Co., Chicago Heights, Ill. **Oct. 1940.**

» «

Murex Alternex. An A-C covered electrode for manual arc welding designed especially for use with transformer type A.C. Welders. Metal & Thermit Corp., New York, N. Y. **Jan. 1941.**

» «

Luminarc 2S. An electrode suitable for welding 2S Aluminum. Universal Power Corp., Cleveland, Ohio. **Nov. 1940.**

Harnimoly. A shielded arc electrode for welding joints and surfaces of high carbon alloy steel which are to be flame-treated. Harnischfeger Corp. **April 1941.**

» «

G-E Type W-30. All position welding electrode conforming to AWS Specification E-6012.

G-E Type W-83 cast iron all position electrode.

G-E Type W-93. A hard-facing electrode for building up surfaces to resist wear from shock, abrasion and rolling impact. General Electric Co., Schenectady, N. Y. **May 1941.**

» «

Agile Yellow Rod. Electrode for use on cast iron. AmericanAGile Corp., Cleveland, Ohio. **May 1941.**

» «

Welding Gauge

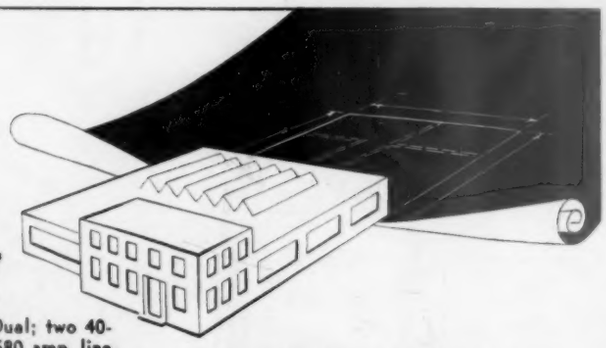
A.W.S. Welding Gauge. A precision built instrument conforming to A.W.S. specifications for checking welds. Chicago Tool & Engineering Co., Chicago, Ill. **Jan. 1941.**

» «

Welding Helmet

Boyer-Campbell Welding Helmet. Welding helmet which features a cover glass which may be removed and inserted from the outside. Also adjustable head band. Boyer-Campbell Co., Detroit, Mich. **Jan. 1941.**

ADD to Your PLANT CAPACITY



New G-R 45-H Special Dual; two 40-300 amp. lines or one 50-580 amp. line

If your production involves arc welding, you can step up output per man-hour, per foot of floor space, per kilowatt of available power . . . overnight . . . with G-R welders.

Manual, automatic and remote-control G-R units from 125 to 2,000 amperes—for single or multi-circuit operation—are ready to handle your job. Write or wire today for complete information.

GLENN-ROBERTS COMPANY
1009 FRUITVALE AVENUE, OAKLAND, CALIF.
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*PATCHES ON SUNDAY PANTS INDICATE HEAVY CONCENTRATION ON PRODUCTION IMPROVEMENT

WHITEY SEZ: *"GOD GAVE MAN TWO ENDS: ONE TO THINK WITH AND ONE TO SIT ON. A MAN'S SUCCESS DEPENDS ON WHICH END HE USES MOST; A CASE OF HEADS YOU WIN AND TAILS YOU LOSE . . . MAURATH STAINLESS ELECTRODES LIKEWISE HAVE TWO ENDS—BOTH VERY BUSINESS-LIKE; BOTH CONTRIBUTING TO THE WELDER'S SUCCESS."*

STAINLESS Type Numbers Available		
302-B	316	330
308	316-Cb.	347
309	317	410
309-Cb.	321	430
310	325	442
311	329	446
312	•	502
15% Cr.—65% Ni.		
20% Cr.—80% Ni.		

HAVE A *SEAT* IN BOOTH D-31 AT THE METAL SHOW—*PATCHES FURNISHED*

MAURATH, Inc.
Builder of better welding

CLEVELAND
electrodes in all analyses

New Product Developments of 1941

Kelley Slide. A device designed to fit in standard welding helmets allowing the operator to raise or lower the helmet entirely by head motion. Kelley Devices, Milwaukee, Wis. **Sept. 1941.**

» «

Welding Machine Trailer

Lincoln. Two wheel rubber tired trailer designed for mounting either Lincoln SAE 200 to 600 amp. A-C motor driven or Type SA 200 special engineer driven type Lincoln Arc Welder. Lincoln Electric Co., Cleveland, Ohio. **Sept. 1941.**

» «

Hobart. A 4 wheel light weight pneumatic tire trailer for mounting Hobart electric drive arc welders. Hobart Brothers Co., Troy, Ohio. **Sept. 1941.**

» «

Productor. Special design welding positioners of all-welded construction capable of automatic positioning. Positioning table may be moved vertically or rotated by electric drive. Bentley Weldery, Syracuse, N. Y. **Dec. 1940.**

» «

Welding Positioner

Ransome Welding Positioner. Positions up to 2500 lb. capacity with all welded table top. Full revolving and capable of tilting 135 deg. beyond horizontal. Ransome Concrete Machinery Co., Dunellen, N. J. **Jan. 1941.**

» «

Model AM-5 Productor. All-welded construction with provisions for power for tilting only, using combination system of compressed air and oil control. Tilts to 90 deg. Bentley Weldery, Syracuse, N. Y. **Jan. 1941.**

» «

Ransome Welding Positioner. A 3000 lb. heavy duty positioner having a motor driven tilting table which may be tilted 45 deg. beyond vertical. Ransome Concrete Machinery Co., Dunellen, N. J. **Sept. 1941.**

» «

Welding Rings

Tube-Turn Welding Rings. Backing rings for use with all types of tube turn welding fittings and straight pipe. Tube-Turns, Inc., Louisville, Ky. **May 1941.**

» «

Welding Rod

Ampco-Trode. Aluminum bronze rod available in 6 standard grades—12, 16, 18, 20, 21 and 22; sizes ⅛", 5/32" or ¼" dia. with light, medium or heavy coating. Ampco Metal, Inc., Milwaukee, Wis. **Oct. 1940.**

» «

Airco High-Text Flux Coated Bronze Welding Rod. A flux coated for gas welding of bronze. This rod is also available in a bare welding rod with the same flux available in liquid paste form. Air Reduction Sales Co., New York, N. Y. **Dec. 1940.**

Welding Torch

Featherweight Series 9 Aircraft Welding Torch. A lightweight torch which weighs 5 ounces, available with interchangeable tips from 1 to 6 inclusive. Dockson Corp., Detroit, Mich. **Oct. 1940.**

» «

Airadiator. An air cooled torch nozzle for use with Victor welding torches. Victor Equipment Co., San Francisco, Cal. **Feb. 1941.**

» «

RegO Aircraft Welding Torch. A lightweight torch weighing only 7 oz. for use in aircraft welding. National Cylinder Gas Co., Chicago, Ill. **Sept. 1941.**

» «

Weldor's Tools

Welder's Pipe Template Patterns consist of a set of 20 blueprints 30x40 in. containing some 300 template drawings such as layouts for tees, ells, laterals, reducers, bull plugs and other pipe fittings. F. W. Bollman, West Lafayette, Ind. **Oct. 1940.**

» «

Util-A-Tool. A clamping tool which consists of 8 pieces of equipment which may be used in various combinations in conjunction with a push and pull jack to help the weldor when welding structural shapes, on reclamation welding or hard facing. Templeton, Kenly & Co., Chicago. **Oct. 1940.**

» «

Weldor's Chipping Hammer. Chipping hammer with renewable wire brush attachment for chipping, cleaning and brushing of welds. May also be obtained without brush, if desired. Chicago Mfg. & Dist. Co., Chicago, Ill. **Jan. 1941.**

» «

Toggle Plier Model 450. A deep throat quick acting plier with variable capacity of 1 in. to 3 in. Knu-Vise, Inc., Detroit, Mich. **Feb. 1941.**

Jorgensen Shield Welder Clamps. A shielded screw C clamp for use in welding operations. Available in several sizes and throat depths. Adjustable Clamp Co., Chicago, Ill. **Feb. 1941.**

» «

Twistight Push-Pull "C" Clamp. A simple C clamp consisting of rolling clutch inside a screw which grabs the smooth rod so that the foot of the clamp may be instantly adjusted to any thickness of material. Mechanics Engineering Co., Jackson, Mich. **March 1941.**

» «

Automatic Vise. A vise arranged so that foot pedals may be used for clamping and releasing the work and vary the pressure needed for any requirement. Automatic Vise Sales Co., Los Angeles, Cal. **April 1941.**

» «

Jackson Electrode Carrier. A vulcanized black fiber reinforced electrode carrying case suitable for carrying 5 or 10 lbs. of electrodes. Jackson Products, Detroit. **May 1941.**

» «

Rapid Hack Saw. Standard and tapered model hack saws featuring a patented automatic tension lock. Rapid Mfg. Co., Glendale, Cal. **June 1941.**

» «

Klampacto. An improved model toggle action C clamp available in 3 models, 5, 6 and 10 in. gauge respectively. Knu-Vise, Inc., Detroit, Mich. **July 1941.**

» «

Welding Jig. An easily adjustable jig for positioning articles to be hard-faced for almost any type of small equipment. Stoody Co., Whittier, Cal. **July 1941.**

» «

Wheel Jig

Alber Wheel Jig. Wheel jig for use in changing streamline wheels on agricultural equipment to pneumatic rims. W. D. Alber, Beatrice, Neb. **April 1941.**

Speedy delivery service should be one of a jobber's aims.

INCREASE THE CAPACITY

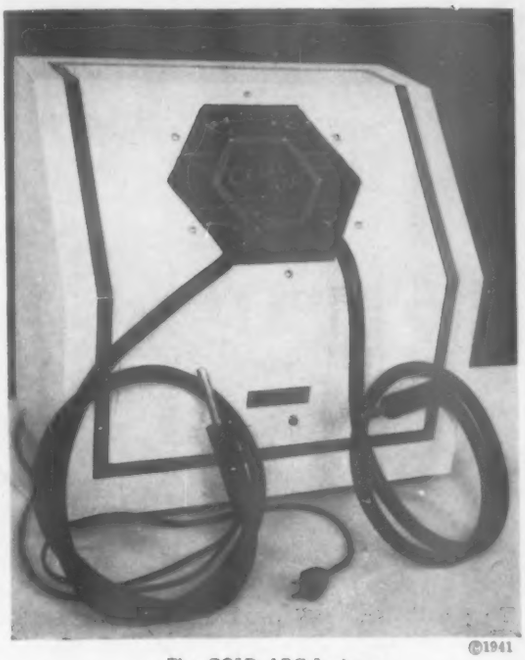
OF

YOUR PRESENT A-C WELDERS

WITH

"COLA ARC" IONIZER

TRADE MARK ©1941



The COLD ARC Ionizer

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DON'T GUESS— GET BETTER WELDS

Every Time

Cheaper and Faster, Too!

Even Inexperienced Operators

Do Good Work with COLD ARC

STRIKE AN ARC ANYTIME—ON ANY METAL—AND WELD IMMEDIATELY

That's just what you can do with your present A-C Welding Units when you use the New COLD ARC IONIZER. Profit by the increased capacity—greater use—of your present equipment.

The COLD ARC IONIZER is a generator of high tension potential—it superimposes a "carrier wave ionizing current" of high oscillation value over the regular A-C welding amperage output of your A-C welder. This "carrier wave" stabilizes the arc. The "carry-over" arc, being at high tension, so ionizes—or burns out—the oxygen-nitrogen air mass in its path that less resistance is offered to the welding arc's passage.

A-C WELDING NOW PRACTICAL ON SOFT AND THIN FERROUS AND NON-FERROUS MATERIALS

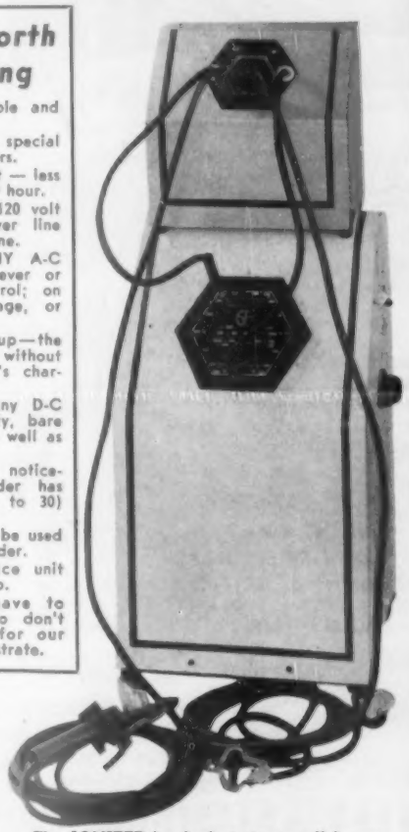
With less resistance to the welding arc the COLD AIR IONIZER permits truer amperage welding with A-C machines. Aluminum and stainless steels can now be readily welded with the COLD ARC IONIZER in your present A-C welder circuit. "Ionizing" produces a de-oxidizing effect—provides steady welding of ferrous and non-ferrous alloys, of thin sheets (stainless and galvanized) or of castings.

OVERCOME OPERATOR SHORTAGE—NOW ANYONE CAN STRIKE AND HOLD AN ARC AND LAY A GOOD BEAD

Anyone can get a fast-struck, steady welding arc—a hotter, faster arc with better penetration and less undercutting. With the COLD ARC IONIZER it's simply easier welding with less amperage requirements. COLD ARC SAVES both the OPERATOR'S TIME and the COMPANY'S CURRENT.

Features Worth Investigating

- Safe — Sure — Simple and Fool proof.
- No moving parts; special size for H.D. Welders.
- Low operating cost — less than ½c per current hour.
- Plugs into any 110-120 volt A-C 60 cycle power line without upsetting line.
- Applicable to ANY A-C Welder; plug-in, lever or stepless type control; on any mainline voltage, or cycle.
- Improves—speeds up—the A-C welding ARC without changing the ARC's characteristics.
- Permits use of many D-C str. or rev. polarity, bare and dusted rods as well as all A-C rods.
- Value particularly noticeable if your welder has low amperages (5 to 30) available.
- Welder can always be used as straight A-C welder.
- Special Interference unit filters Radio pick-up.
- We expect to have to prove its value—so don't hesitate to ask for our travelers to demonstrate.



The IONIZER hooked up to a well known Welder ready for use.

ASK FOR DEMONSTRATION—IN YOUR OWN SHOP—WITH YOUR OWN EQUIPMENT—ON YOUR OWN WORK

Benefit from the many practical installations that have already been made. If you work with STAINLESS; CHROME T, S or #27; or ALUMINUM you will be particularly impressed with what COLD ARC can do in your shop. On any and all A-C production or maintenance welding a demonstration requiring only a simple set-up will prove mighty worth your while. We predict you will never return to the straight A-C method, once you have tried the New COLD ARC way—it is SO MUCH faster and efficient.

Write Today for Demonstration and Full Particulars

THE A—C—DEVICES COMPANY

912 W. VAN BUREN STREET **CHICAGO, ILLINOIS**

New Products . . . .

FOR HOLDING WORK while WELDING
Use DE-STA-CO Toggle Clamps AND Pliers
Welding fixture using De-Sta-Co Clamp to hold parts for assembly.
Small aircraft clamp holding wing frame for welding operations.
De-Sta-Co Toggle Pliers holding pressed metal parts for spot welding.

De-Sta-Co Toggle Clamps complete line, all sizes.

DE-STA-CO
Toggle Clamps

Used to hold production parts in fixtures for welding or assembly operations.

Easy, positive clamping, instant release.

Complete line from small aircraft size to heavy air actuated clamps. Send for Bulletin No. 40, gives complete details.

"C" CLAMP
With Quick Acting
TOGGLE MOVEMENT

Different from any other clamp you have ever used. Send for literature.

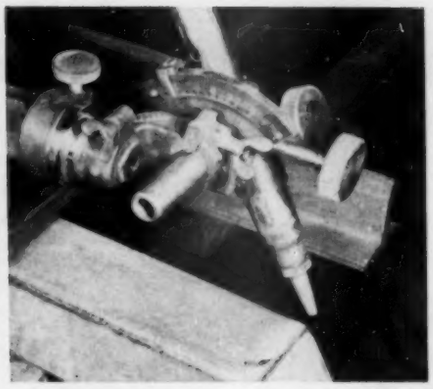
De-Sta-Co Toggle Action "C" Clamp.

De-Sta-Co Toggle action Pliers have many uses.

DE-STA-CO
Toggle Pliers

Automatically locks into position until manually released.

DETROIT STAMPING CO.
Established Over 25 Years
334 Midland Ave • Detroit, Mich.



Bevel cutting is easy with this protractor attachment.

Torch Holder

★ **Air Reduction Sales Co.**, New York, has announced the development of a new **Protractor Type Torch Holder** for use with Radiagraph cutting torches.

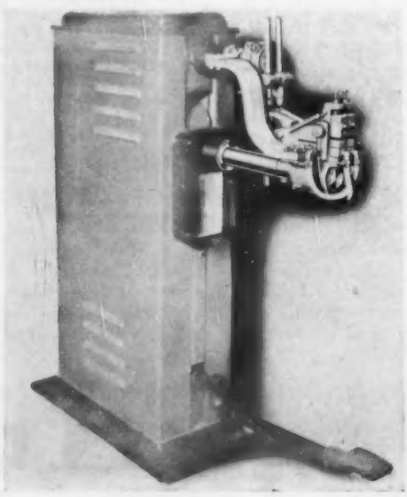
The new holder which has a 90° angle range can be attached to any standard Airco Radiagraph. A circular knurled knob permits angular adjustment as shown on the scale.

» «

Welding Attachment

★ Any rocker arm type Spot Welder may now be quickly converted into a butt welder by simply removing the arms and inserting in their place the upper arm and lower arm sections of the **Universal Butt Welding Attachment.** No cables or rods needed as entire operation is automatically carried out by motion of upper arm.

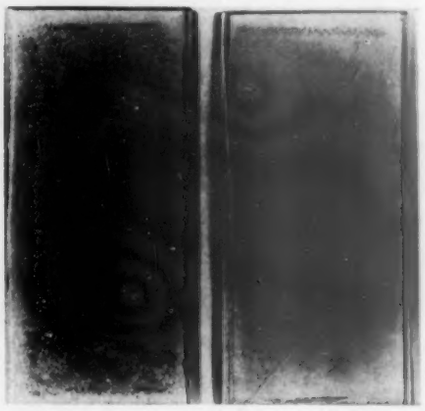
A step on the pedal clamps jaws simultaneously, pushes movable die toward stationary slide, applies weld current, completes weld and upset and pulls the slide back ready for next weld. Butting surfaces quickly forged with uniform porosity free weld practically equal to parent metal in strength.



A butt welding conversion unit for a spot welder.

Available in two sizes—two to 10 K V A and 12 to 25 K V A—the first good for ⅜ dia solid stock, the second up to ¾" dia solid.

The jaws of the larger unit may be extended to 1" dia. Both units may be used for making butt welds on tubular stock.



These two lens were exposed to weld spatter for the same length of time yet the protected lens (right) is comparatively spatter-free.

Lens Protector

The Laboratories of the **John C. Dolph Co.**, 170A Emmett Street, Newark, N. J., have developed a new material for use on glass to prevent breakage or pitting of the surface by welding spatter during welding operations.

This material, known as **Dolph's No. 253 Glascote Clear,** originally developed for use on electric bulbs and port-hole lights, is now used on welding helmet and goggle lenses, it is claimed, with very satisfactory results.

The method of application is by dipping and the material air dries on flat surfaces in thirty minutes. It is transparent and will not darken under heat. A lens coated with Dolph's No. 253 Glascote Clear is protected from spatter and pitting for an indefinite period and can be reprotected by subsequent applications.

» «

Hydraulic Vise

★ A new hydraulic vise has been introduced by the **Studebaker Machine Co.**, Chicago.

The new **Studebaker Hydraulic Vise** is operated entirely by foot control, by stepping on one pedal moves the vice jaw to contact against the work. A second pedal applies pressure up to 5 tons. A third pedal releases the jaw.

Some of the different types of jobs this new vise is said to be capable of performing are press work, punching, bending, cutting, straightening, testing, and stamping.

The vise mounts horizontally on any type of bench as well as vertically on wall or post. In addition it can be

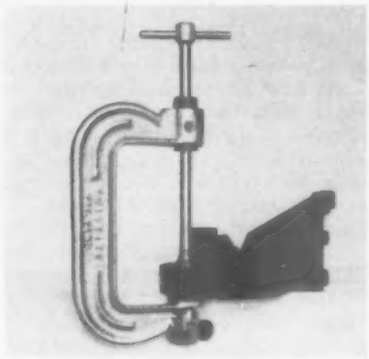
mounted on a portable stand, as a movable, self-contained unit. Special jaw faces can be applied.

Construction is all semi-steel. The hydraulic pump is precision fitted to insure accurate operation and long life. The sliding jaw and base are accurately machined to insure accurate fit of the two jaws. Pump and Ram cylinders are honed and polished.

Two sizes are available in the new vise—5" width between jaws and 7½" width.

A new bulletin is available with complete information about the Studebaker Hydraulic Vise. Write to the Studebaker Machine Co., 9 S. Clinton St., Chicago, Ill., mentioning this magazine.

» «



Double duty from this ground clamp.

Ground Clamp

★ **Michigan Clamp Co.**, Box 243, Jackson, Mich., announce the development of a new **Twistite Ground C Clamp.** This clamp, which combines the instant adjustment features of the Twistite C Clamps with its splatter-proof treated frame pressure rod and swivel foot, is also fitted with a lug to receive the welding cable. The manufacturer claims that the advantage of the clamp is that it provides a C clamp for holding the work as well as a positive ground connection which holds the cable securely.

» «

Grinding Wheel Dresser

★ The **Ideal Commutator Dresser Co.**, 1935 Park Avenue, Sycamore, Ill., announces a new abrasive wheel type **Grinding Wheel Dresser** that is said to give a cutting and truing effect almost equal to that of a diamond.

The cutting wheel is held in a protective metal housing which deflects the grindings away from the operator. A large handle makes it convenient to hold and use. The cutting wheel is replaceable when necessary.

Besides general cleaning and truing of a grinding wheel, other uses include the truing of cut-up and uneven sides, dressing out deep grooves and out-of-roundness, restoring out of balance wheels into true rotating ones. It can also be used to shape wheels into different forms when form grinding is desired.

GIVE ME "CM-50" Every Time

for welding high tensile steels

Here's an electrode ready for action . . . and getting plenty of it on such work as the welding of carbon moly high pressure and high temperature piping. Use it also on high strength, low alloy steels. You'll like the X-ray clean welds you get with these simple procedures. And uniform physical properties show tensile strength of from 75,000 to 80,000 lbs.; yield point 65,000 to 70,000 lbs.; elongation in 2", 15 to 20%. Write for facts.

P&H WELDING ELECTRODES

Here's a Welding Range from 200 down to 15 amps.

Yes, you can get it *now*, this small, compact, more efficient welder. With one simple control it gives you automatic arc response on all types of work. Makes welding easier, results more uniform.

P&H TYPE WD-150
Square Frame Welder

Horizontal operation means more dependable performance, less maintenance. Simple parallel hook-up gives you any desired capacity. Outstanding in performance and value. Write for Bulletin W-28.

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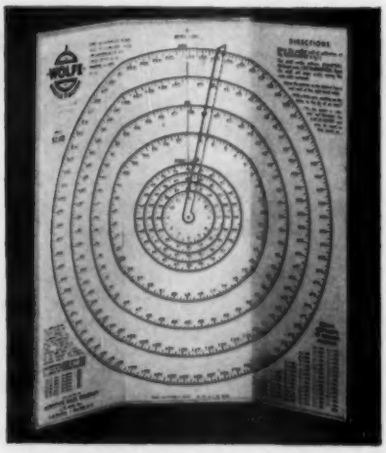
Circle Meter

★ The **Wolfe Circle Meter** is a new folding chart which was recently placed on the market by the **Interstate Sales Co.**, 1123 Broadway, New York. This chart is designed to give instantaneous readings of diameters and circumferences of any circles up to 72 in. in diameter, in steps of ⅛ in. or smaller. All readings are in fractions of an inch, making the use of decimals unnecessary. Inasmuch as the chart is strongly made and can be folded, it will be convenient for weldors and sheet metal workers working in the field.



Aided by this chart diameters and circumferences are easily obtained.

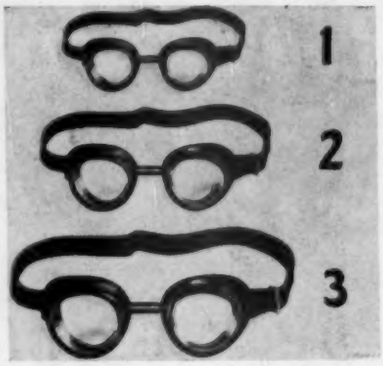
» «

Aircraft Drills

★ The U14FS series—¼" **Aircraft Drills**—is announced by the Independent Pneumatic Tool Co. Claimed particularly useful for operation in very limited space or in unusually difficult positions these U14FS drills have the power reserve and construction ruggedness necessary for high speed production. Of small size and compact design they are available in three different speeds and have side switch style handle for either continuous or intermittent drilling.

For further information on this tool write to the **Independent Pneumatic Tool Co.**, 600 W. Jackson Blvd., Chicago, Ill.

A lightweight drill for high speed production.



Safety goggles in 3 sizes.

Goggles

Face-Fitt is the name of a new line of safety goggles recently announced by **Kimball Safety Products Co.**, 7314 Wade Park Ave., Cleveland, Ohio. For the first time, according to the manufacturer, a line of composition-frame goggles is available in three sizes (42x 45, 45x48 and 48x51 mm.). All are drop-eye shape, which suits the contour of the eye socket better than round lenses and is especially adapted to workmen's use. Extraordinary comfort is claimed for them by the maker. "Face-Fitt" goggles are light weight and ventilated top and bottom with more than 700 holes as contrasted with the minimum of 265 holes required by government standards.

» «

Tool Post Attachment

★ A new **Tool Post Attachment** for lathes, driven by a Stow portable flexible shaft machine, is being produced by **Stow Manufacturing Co., Inc.**, Binghamton, N. Y. By its use, a lathe may be adapted to many different grinding operations, both external and internal. The device accommodates grinding wheels as large as 6 in. dia. x 1 in. face.

On the tool end the tool post attachment is fitted with a combination radial thrust and annular ball bearing, and on the shaft end, a floating, self-aligning ball bearing is used. The unit will operate at speeds as high as 6800 R.P.M.

» «

Carbon Brazing

★ The **Acro Welder Mfg. Co.**, 1825 West St. Paul Ave., Milwaukee, Wis., announce a new **Incandescent Carbon Brazing Machine** for heavy duty work. This unit is a self-contained unit suitable for use with either 220 or 440 volt power supply.

While it weighs about 1800 lbs., it is entirely self-contained and may be readily transported about the shop by means of a crane. By means of a special electronic timing device, cooling water circulates through the transformer, cable and tongs, while a thermostat mounted in the water supply tank makes its operation fully automatic.

Low Temperature Alloy

★ The **Eutectic Welding Alloys, Inc.**, New York City, announce the development of a new low temperature alloy, **"Coldweld,"** for the low temperature welding of cast iron castings.

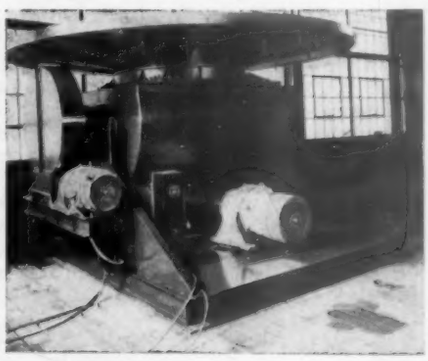
» «

A hack saw frame for heavy work, a knuckle guard, too.

Heavy Duty Hack Saw

★ The new **RH-12 Rapid Heavy Duty Hack Saw Frame**, as developed by the **Rapid Mfg. Co., Inc.**, P. O. Box 488, Glendale, Cal., is designed for use in the field of heavy cutting. This frame is made of solid steel, one piece, and will accommodate either hand or power blades at such tension that the blades can not twist or turn. Power blades are 'locked' into the frame and can only be removed from the pins by releasing the automatic locked tension. This frame carries all the patented features of the Rapid line, including the patented Knuckle Guard.

» «



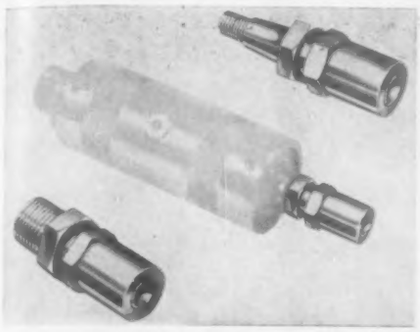
An ideal positioner for a shipyard.

Welding Positioner

★ The **Mississippi Valley Structural Steel Co.**, Melrose Park, Ill., are introducing through their sales agents, the **Machinery & Welder Corp.**, Chicago, a new heavy duty **Welding Positioner.** Designed for positioning heavy machine parts, it has a working capacity of 36,000 lbs. and is full revolving as well as capable of tilting 90 deg.

The tilting mechanism is worm gear driven by a 20 H. P. motor at a speed of 0.38 r.p.m. The table turning mechanism, another worm gear drive, is driven by a 10 H.P. motor at 0.52 r.p.m.

The positioner turntable is 13 ft. 11 in. in dia. while the positioner itself has an overall height of 8 ft., a length of 13 ft. and is 8 ft. 11 in. in width. Its shipping weight is 73,331 lbs.



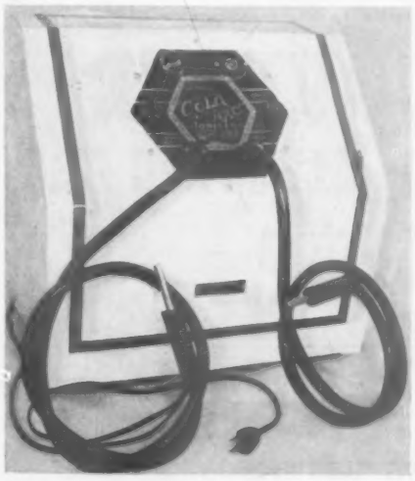
A compact chuck for flexible shaft equipment.

Collet Chuck

★ A compact, single purpose **Collet Chuck** which can be attached quickly to hand-pieces used on Stow flexible shaft machines has just been brought out by **Stow Manufacturing Co., Inc.,** Binghamton, New York. The new unit is furnished in two sizes, one with ¼-inch and the other with ⅜-inch chucking capacity.

This new attachment is made in two styles. With the straight-threaded, hex-head stud, the collet chuck interchanges with the clamp spindle on the standard hand-piece. With the tapered shank it fits into the tapered socket of the high-speed hand-piece, a type used with rotary files, mounted points or other high-speed tools, to assure true running on precision work.

The tapered type of collet chuck will also fit a tool post attachment for grinding operations with a lathe.



High-frequency A-C current from this unit.

A-C Welder Attachment

★ The **A-C Devices Co.,** 912 W. Van Buren St., Chicago, announce the development of a new high frequency converter for use with 60-cycle A-C welders. Known as the **"Cold-Arc,"** this unit is claimed suited for attachment to any 60-cycle A-C welder. It is also stated that because of its high frequency it is possible to weld stainless steel aluminum and ferrous and non-ferrous alloys with an A-C welder.

Perspiration Retainer

★ A new lightweight absorbent sweatband, made of synthetic sponge, is announced by the **American Optical Co.,** Southbridge, Mass. The sponge is 7½" long, covers a generous width of brow and can be sterilized, used again and again. It keeps sweat out of eyes and off goggles, thereby keeping vision clear so that foundrymen, welders, and other workers on hot jobs won't get blindly into harm's way.

This band will keep perspiration from the eyes.

Welding Rods . . . not too plentiful, BUT . . .

if you need stainless electrodes for defense work, alloy and hard surfacing rods or other electrodes for special, out-of-the-ordinary applications, we can probably help you. Call the nearest Ryerson plant.

Electrodes in stock include:

McKay Stainless—7 types

Ryerson Shielded Arc — for Mild Steel and Alloys

Blue Coated — For Cast Iron

Phosphor Bronze—For Brass and Copper

Hard Surfacing Rods

Acetylene Welding Rods

●

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Specifications for Ferrous Materials

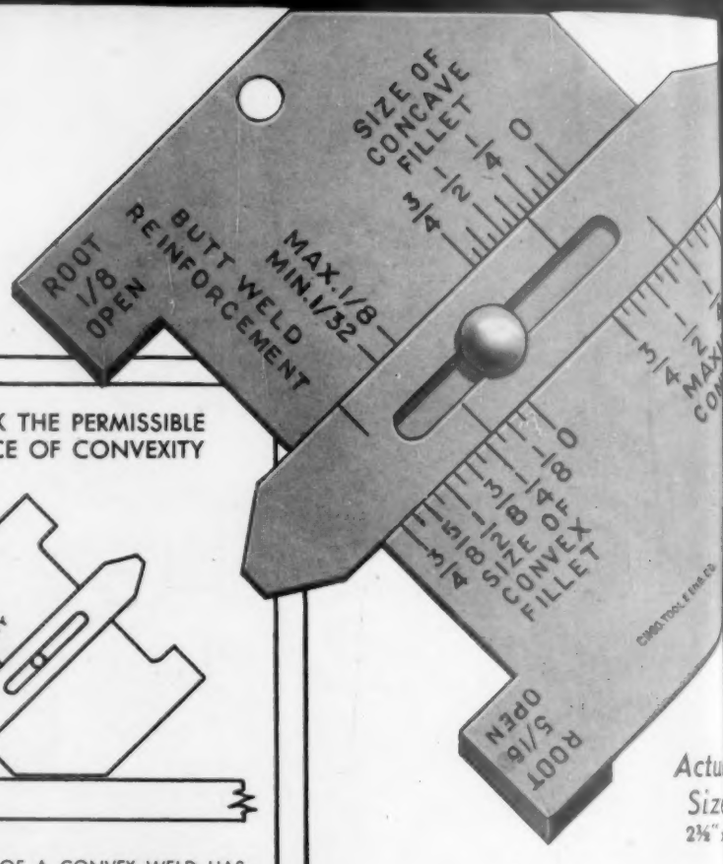
MATERIAL		A.S.T.M.	A.S.M.E. (Boiler)	C Max	Mn Max.	Si Max	Cu Min.	Ni	Cr	Tensile Kips Min.	Yield Point Kips Min.	Elong. in 2" %-Min.	Red. in Area %-Min.	REMARKS
Structural Steel	Bridges	A7-36					.20[2]			60/72	0.5 T.S. 33 min.	22		Rolled Steel Base Plates Over 2" in Thickness C-0.20/0.35%
	Buildings	A9-36					.20[2]			60/72	0.5 T.S. 33 min.	22		
	Mild Steel	A10-34					.20[2]			55/65	0.5 T.S. 30 min.	24		T.S. For Cars 50/65
	Locomotives	A113-33					.20[2]			55/65	0.5 T.S.	22		
	Silicon	A94-36				.20 min.				80/95	45	16/19[1]	30	
	Ships	A131-36								60/72	0.5 T.S. 33 min.	22		
Boiler Steel	Locomotives Flange	A30-33			.30/.60					55/65	0.5 T.S.	23/27[1]		
	Firebox			.30	.30/.60					52/62	0.5 T.S.	25/30[1]		
	Stationary Flange	A70-36	S-1		.80					55/65	0.5 T.S.	23/27[1]		
	Firebox			.30	.80					55/65	0.5 T.S.	24/28[1]		
	High Tensile Grade A	A149-36	S-26	.33	.90	.25				65/77	0.5 T.S.	20/24[1]		Flange
				.33	.90	.25						21/25[1]		Firebox
	Grade B			.35	.90	.25				70/82	0.5 T.S.	19/22[1]		Flange
				.35	.90	.25						20/23[1]		Firebox
	High Tensile Grade A	A150-36	S-27	.35	.50/.90	.25				65/77	0.5 T.S.	23/27		A-149-36-Plates 2" and under in Thickness A-150-36-For Fusion Welded Pressure Vessels Plates over 2" to 4" incl.
	Grade B			.35	.50/.90	.25				70/82	0.5 T.S.	21/25		
	Marine Grade A	A114-33								60/70	0.5 T.S.	21/25[1]		
	Grade B									55/65	0.5 T.S.	24/28[1]		
	Iron Plate Type A	A129-33	S-25		(No-min.)					44	27.5	25 (8")		
	Type B				.65		.40			44	27.5	25 (8")		
	Type C						.20			44	27.5	25 (8")		
Steel for Welding	Flange and Firebox Grade A	A89-33	S-2	.17	.35/.60					45	0.5 T.S. 24 min.	33[1]		Elong. Requirements for Firebox Quality about 1% Higher
	Grade B			.22	.35/.60					50	0.5 T.S. 27 min.	30[1]		
	Structural Quality Grade A	A78-33		.17	.35/.60					45	0.5 T.S. 24 min.	28 (8")		
	Grade B			.22	.35/.60					50	0.5 T.S. 27 min.	25 (8")		
Wire for Concrete Reinforcement		A82-34								80	0.8 T.S.		30	
Steel Tires	Class A	A26-16		.50/.70	.75					105		12	16	
	Class B			.60/.80	.75					115		10	14	
	Class C			.70/.85	.75					125		8	12	
Iron and Steel Chain	Crane Proof	A56-30			.30									See Specifications for T.S. and Elong. Tests on Finished Chain
Steel Tubes and Pipe	Fusion Welded Grade A	A139-36								48	30	30		8" to 30" Diameters
	Grade B									60	35	25		Also Hydrostatic Test
	Fusion Welded	A134-36												50" Dia. and Over Hydrostatic Test Only
	Resistance Welded Grade A	A135-34								48	30	30		
	Grade B									60	35	25		Also Hydrostatic Test
	Forge Welded Grade A	A136-34		.35/.60						45	0.5 T.S. 24 min.	28 (8")		
	Grade B			.35/.60						50	0.5 T.S. 27 min.	25 (8")		Also Hydrostatic Test
	Lock Bar	A137-34								40/50	0.5 T.S.	28 (8")	50	
	Lapweld & Seamless Boiler Tubes Grade A	A83-36	S-17	.08/.18	.30/.60									
	Grade B			.03	.03									Also Flattening, Crush, and Hydrostatic Tests
	Grade C			.35	.80					60	37	25		
	Welded & Seamless Welded A. Bessemer	A53-36								50	30	18 (8")		
	O.H. or E.F									45	25	20 (8")		
	Seamless O.H. or E.F. Low Carbon									48	26.5	35		Also Hydrostatic and Flattening Tests
	O.H. or E.F. Medium Carbon									62	35	25		
High Temperature Service	Fusion Welded Grade A	A155-36		.17	.30/.60					45	0.5 T.S. 24 min.	33[1]		
	Grade B			.22	.30/.60					50	0.5 T.S. 27 min.	30[1]		Also Hydrostatic Test
	Grade C			.30	.30/.60					55	0.5 T.S.	27[1]		
	Lapwelded & Seamless Welded Open H.	A106-36			.30/.60					45	25	22 (8")		
	Seamless Grade A				.30/.60					48	30	35		Also Flattening and
	Grade B			.40	.35/1.50					62	35	25		Hydrostatic Tests
	Grade C				.35/1.50					75	45	20		
	Forged or Rolled Pipe Flanges	A105-36	S-8											
	Class I				.40/.80					60	30	25	38	
	Class II				.40/.80					70	36	22	30	
Carbon Steel Castings for High Temperature Service		A95-36	S-12	.15/.45	.50 min.	.20 min.				70	.36	22	30	Also Hydrostatic Test
Wrought Iron	Forgings for Locomotives and Cars	A73-36												
	Class A				.07					45	0.5 T.S.	24 (4")	33	
	Class B				.15					45	0.5 T.S.	24 (4")	33	
	Welded Pipe	A72-33	S-19		.05					40	24	12 (8")		Also Hydrostatic Test
Iron Castings	Grey Iron Class No. 20 to No. 60	A48-36									20/60			The Class No. Designates in Kips the Required T.S.- Transverse Tests Optional
	Grey Iron For Valves, Flanges, etc. Class A	A126-30								21				
	Class B									30				Transverse Test Optional
	Cast Iron for Locomotive Cyls.	A45-14												Transverse Test Required
	Cast Iron Pipe	A44-04												Hydrostatic and Transverse Tests Required
	Malleable Iron No. 32510	A47-33								50	32.5	10		
	No 35018		S-15							53	35	18		

1 Approx. for 8 in. varies with T.S.

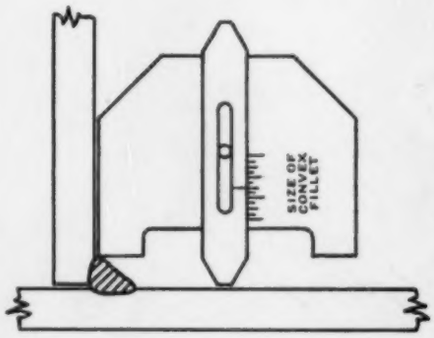
Courtesy International Acetylene Assn.

Precision Welding Gauge

For Accurate Calibration of Butt and Fillet Type Welds

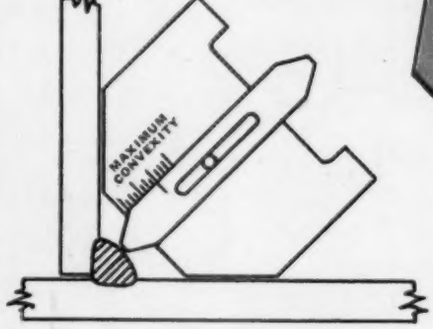


TO DETERMINE THE SIZE OF A CONVEX FILLET WELD



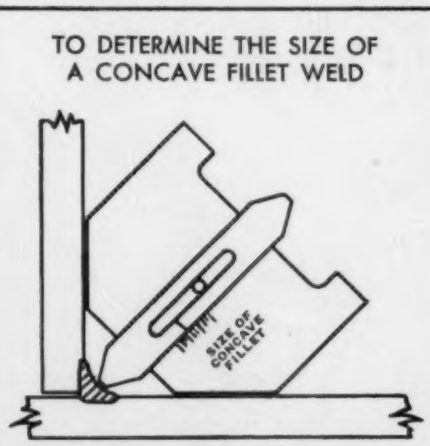
PLACE GAUGE AGAINST THE TOE OF THE SHORTEST LEG OF THE FILLET AND SLIDE POINTER OUT UNTIL IT TOUCHES STRUCTURE AS SHOWN. READ "SIZE OF CONVEX FILLET" ON FACE OF GAUGE.

TO CHECK THE PERMISSIBLE TOLERANCE OF CONVEXITY



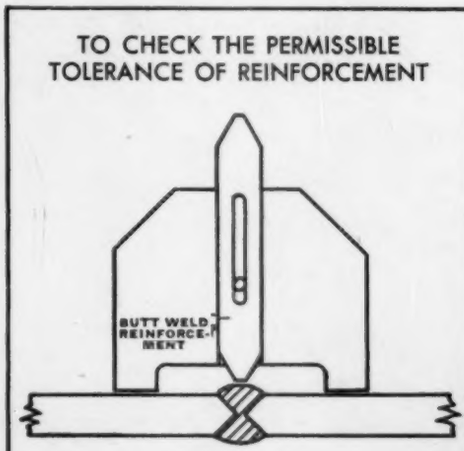
AFTER THE SIZE OF A CONVEX WELD HAS BEEN DETERMINED, PLACE THE GAUGE AGAINST THE STRUCTURE AND SLIDE POINTER UNTIL IT TOUCHES FACE OF FILLET WELD AS SHOWN.

TO DETERMINE THE SIZE OF A CONCAVE FILLET WELD



PLACE GAUGE AGAINST STRUCTURE AND SLIDE POINTER OUT UNTIL IT TOUCHES THE FACE OF THE FILLET WELD AS SHOWN. READ "SIZE OF CONCAVE FILLET" ON FACE OF GAUGE.

TO CHECK THE PERMISSIBLE TOLERANCE OF REINFORCEMENT



PLACE GAUGE SO THAT REINFORCEMENT WILL COME BETWEEN LEGS OF GAUGE AND SLIDE POINTER OUT UNTIL IT TOUCHES THE FACE OF WELD AS SHOWN.

Actual Size 2¾" x

With the new Welding Gauge shown above, it is now possible to meet exacting specifications of butt and fillet type welds. New instrument is of convenient pocket size and is easy to operate. Diagrams at left illustrate the ease with which welders may accurately check size of convex or concave fillets as well as butt weld reinforcements. Instrument is precision-built of chromium plated steel with dimensional readings clearly indicated. Conforms to specifications of A.W.S. Price $3.00

CHICAGO TOOL & ENGINEERING CO

8392 South Chicago Ave.
Chicago, Illinois

Portable Spot Welder

★ A line of "portable" spot welding machines, with built-in transformers designed for suspension from monorails, etc., has been announced by **Progressive Welder Co.**, Detroit. While they may be used for much of the work now done on pedestal welders they are claimed to have particular advantages. Like welding guns they may be moved or swung around to bring the gun to the work, reducing work handling. Like pedestal welders they have rigid arms with a high degree of throat depth, and the higher degree of efficiency going with the eliminating of secondary cables.

The new machines are obtainable in a complete range of sizes from 35 to 400 KVA, and with arm lengths ranging up to a practical maximum of 36 inches of throat depth. Arms are adjustable as to length.

Electrode tips are water cooled. Water connections are brought back along the welding arms to the support housing, to connect them to the same supply line as is used for cooling the welding transformer. Foot controls are connected by flexible cable to control circuit junction box mounted on the transformer. Transformers are provided with heat control selectors.

» «

A-C Welder

★ An **A-C Welder** having a welding current range from 15 to 250 amps. in 30 heat steps has been announced by the **Allen Electric and Equipment Co.**, 1044 N. Pitcher St., Kalamazoo, Mich. The manufacturer states that this equipment has passed the 8 hour burn-out test of the National Board of Michigan Underwriters for 250 amp. duty. The welder is mounted on swivel casters and may be moved readily about the shop.

» «

Gun Welding Cable

★ A line of low cost kickless welding cables of "full concentric" design for reduced current loss and with positive and negative current strands wound at steep helical angles to increase ease of flexing and reduce wear are announced by **Progressive Welder Co.**, 3050 E. Outer Drive, Detroit, Michigan.

Developed by Progressive in conjunction with Habirshaw Cable & Wire Co., the new "P-H" cables are available in a complete range of capacities to suit almost any portable gun welding used.

The new kickless cables have a rated capacity 50% in excess of conventional cables of the same size. The water supply core of the cable consists of ⅜" interlocked bronze tubing having high flexibility characteristics. Six current carrying bundles, of seven copper strands each, enclose this core and are so formed that any flexing causes them to "unwind" rather than bind. A heavy reinforced rubber insulating tube separates these inner strands from the outer strands which are also wound at steep helical angle. Between the outer strands and the external, extra-heavy abrasion resistant cable covering is space provided for water circulation.

» «

New Electrodes

★ Two new welding electrodes called **Harmomang A** and **Harmomang B** which have just been announced by the Harnischfeger Corp. for building up and reinforcing 11-14% Manganese steel or carbon steels where high resistance to impact and abrasion is desired.

Type A is a coated manganese-molybdenum electrode on which the thin coating acts as an arc stabilizer and affords protection against loss of manganese and molybdenum. Type B is a bare manganese-molybdenum electrode providing an austinetic deposit.

Both of these Harmomang electrodes are suggested on such work as building up dipper lips and runners, hammer mill parts, dredge pump shells, rock crusher parts, railway frogs, road grading and mining equipment, etc.

Complete information on physical properties, applications and procedures may be had upon request to the **Harnischfeger Corp.**, 4513 W. National Avenue, Milwaukee, Wis.

TOP, BOTTOM AND SIDES WITH JUST ONE "SET-UP"

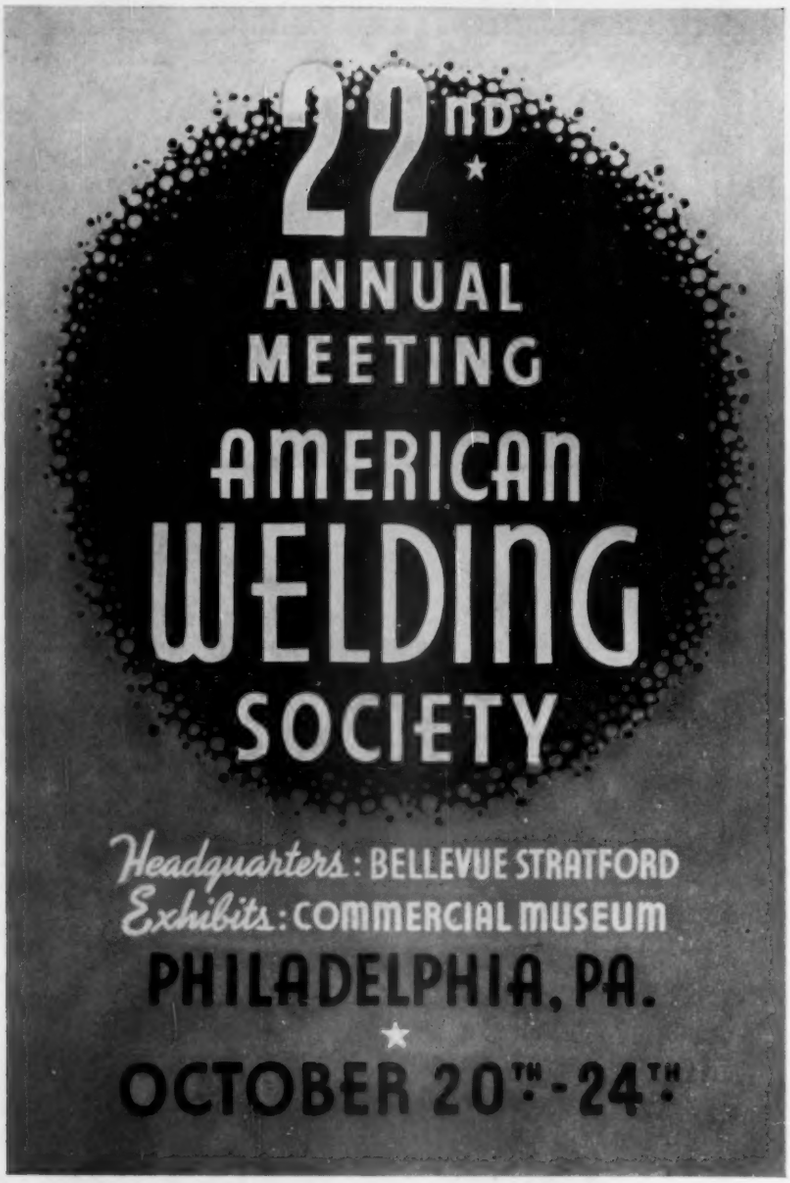
C-F Positioners provide a minimum of 24 different positions necessary for "downhand" welding on these jobs—top, bottom and sides.

Such handling economy means definite savings in welder's time, and crane service. It also means more safety for men and materials as well as better welding procedure.

Write today for Bulletin W P 20, the story of economy in welding showing the various sizes of C-F Positioners—their features, capacity and application to modern industrial production.

Illustrated here is 14,000 lb. capacity Positioner loaded with an unwieldy structural shape which can be maneuvered for convenient approach to every weld required. Maximum handling safety is assured with only one mounting of the assembly.

CULLEN-FRIESTEDT CO.,
1309 S. KILBOURN AVE. CHICAGO, ILLINOIS



Sessions devoted to NATIONAL DEFENSE, SHIPBUILDING, AIRCRAFT and AUTOMOTIVE INDUSTRIES and many other interesting and timely subjects

★

In the light of the defense program and the many new developments and applications of welding your attendance this year is more important than ever. You owe it to yourself to be present.

AMERICAN WELDING SOCIETY

33 West 39th Street, New York City

TAKE PART IN

THE METAL INDUSTRY'S

BIGGEST DEFENSE MANEUVERS!

PHILADELPHIA, OCTOBER 20-24

The entire metal industry is pooling its knowledge of defense production and conservation at the 1941 Metal Congress & Exposition in Philadelphia, October 20-24.

Under direct request of many manufacturers a comprehensive program of group meetings on Defense Problems, Conservation and Substitution has been prepared. These group meetings are not to be of the ordinary round-table type where everything is left to chance but are to be well-planned presentations.

A representative will present at each meeting the latest information on the scarce materials involved in the clinic and the status of substitute materials, also indicating how industry can assist in and adjust itself to the present shortages. Since meetings will be "off-the-record" men of industry will be free to discuss actual production problems and quote examples.

Subjects to be discussed include alloy steels, stainless, molybdenum, tool steels . . . alloy castings . . . bearing metals . . . shells . . . aluminum . . . magnesium . . . copper . . . inspection of metals . . . priorities, etc.

In addition to these afternoon and evening clinic meetings, more than 80 technical papers will be presented at regular annual meetings of the four technical societies who cooperate in the Metal Congress.

And—at the Metal Exposition—the exhibits of 300 leading manufacturers in the metal industry (largest show ever held) will feature the latest, most modern materials, equipment, and processes for speeding production.

Don't miss the opportunity of hearing the nation's leading defense experts in Philadelphia—your defense job demands representation at the Metal Congress & Exposition!

COOPERATING SOCIETIES

American Welding Society. Wire Association. American Society for Metals. Iron & Steel Division and Institute of Metals Division, American Institute of Mining & Metallurgical Engineers.

Address: W. H. Eisenman, Secretary, American Society for Metals, 7317 Euclid Ave., Cleveland, O.

OCT. 20-24

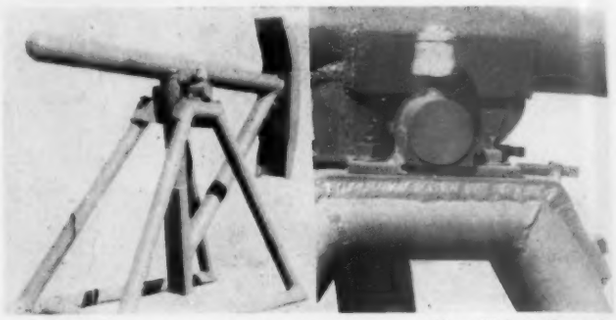
NATIONAL METAL CONGRESS AND EXPOSITION

PHILADELPHIA PUBLIC AUDITORIUMS

Managed by THE AMERICAN SOCIETY FOR METALS

Photo Lincoln Electric Co.

A job shop pump jack with long life.



A specially designed pump jack (left) and its unique bearing (right).

Photo Hobart Bros. Co.

Welded Pump Jack

By Fred Konser

A Minnesota welding shop has made and sold about 35 arc welded jacks in the last year and a half, mostly to farmers getting the rural electricity. The pumps work very effectively with an electric motor mounted on top and a set screw provides adjustment so that the belt may be tightened.

The jacks are made from the rear end of an old car and are equipped with roller and ball bearings. Gears run in oil. Most users employ ¼, ⅓ or ½ hp electric motors, depending on depth of well and on whether water has to be forced. The large pulley, which is all welded, has a flat face and a V-belt connected to a V pulley on a motor. Two ½ in. V-belts are used on the ½ hp motor. On gas engines, a flat belt is used.

» «

Auto Transport Trailers

Streamlined auto carriers, 95% constructed by arc welding are now built by the Dominion Truck and Equipment Co., Kitchener, Ont. The construction of the trailer by arc welding made it 795 lbs. lighter than a similar model of riveted construction. Most of the welds in the trailer were plug welds with the metallic arc. The floor, which was constructed of 14 gage galvanized sheets, was welded along the seams with ⅛" bronze rods so that the galvanizing would not be damaged.

» «

Welded Walking Beam

By R. E. Fillmore

Special drilling equipment is difficult to secure promptly while manufacturers are rushed with defense work. Small welding shops, however, are helping to relieve this situation by building drilling equipment to meet the specific needs of local customers.

A job welder in Augusta, Kan., constructed a pump jack from used pipe. Features of this original designed pump jack are adjustable mule heads made from a used brake band; replacable beam pin (most jacks have pin welded to beam); automatic bearing oilers. Steel bearing (inset photo) was constructed from angle iron welded to pipe. Standard size brass bushings were pressed inside the bearing pipes and caped with a cast iron plug. Walking beam was constructed in a similar manner by welding angle iron to the beam, then fish plating and sleeving the under side so that the pin would be held solid to the beam and work in the bearing on both sides. These pump jacks required very little servicing and are very inexpensive to construct.

» «

Locomotive Frame Welded

Emergency welding repair on a giant locomotive of the Rutland Railroad allowed it to resume service in only a fraction of the time required for replacement of parts. The locomotive frame broke under the cylinder saddle where due to the nature of the break it was impossible to secure expansion or make a V on both sides of the crack.

The welding procedure was as follows: The crack was cut out with an acetylene torch. After scarfing, the sides of the V were chipped free of all oxide and scale. Using a 400-ampere welder, a weld was started on the bottom side and built up. As the weld increased in width, beads were laid with a 1-inch wide oscillating motion. Each layer was thoroughly cleaned with an air hammer and peened.

The job was completed by one operator in eight hours using 52 pounds of ¼-inch welding rod.

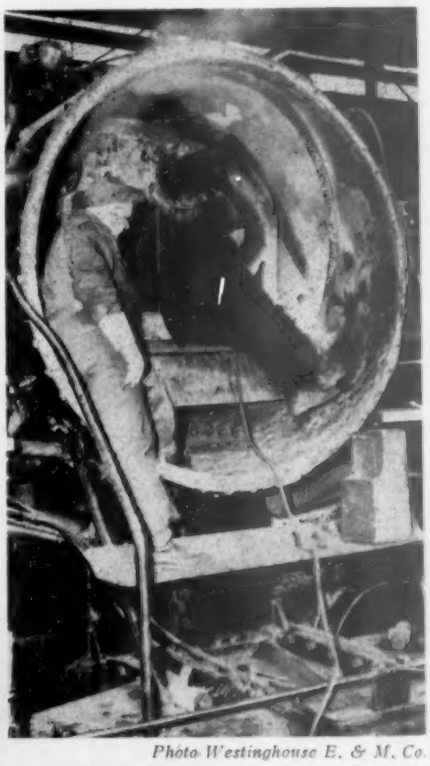


Photo Westinghouse E. & M. Co.

Out-of-Service Days were cut to hours by welding when the frame broke on this 239-ton locomotive.

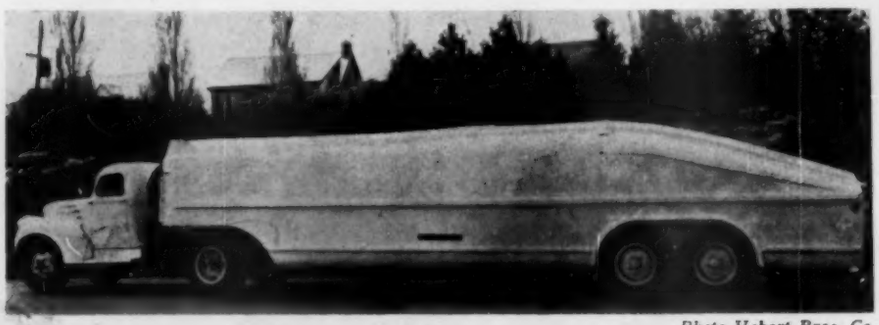


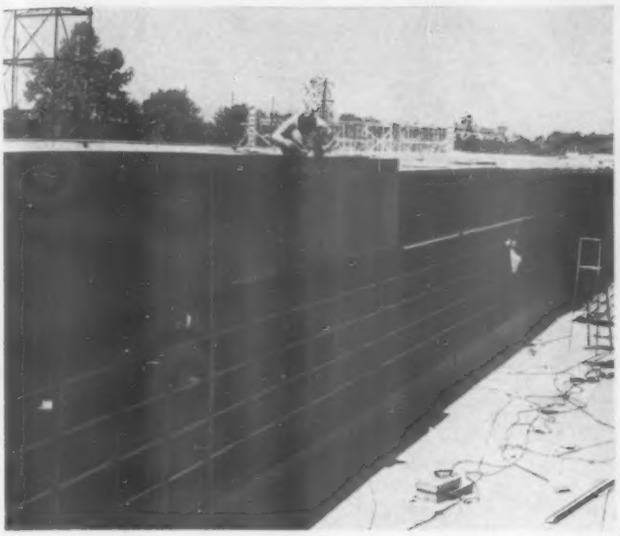
Photo Hobart Bros. Co.

A streamlined auto carrier of welded design.

Be sure and visit The Welding Engineer's Booth (H-53) at the 1941 Metal Show.

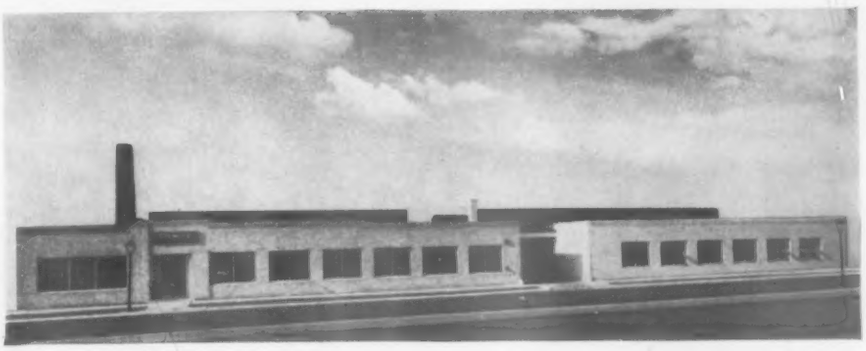
You may win a Welding Encyclopedia.

New Buildings for the Manufacturers



Another addition for the Hobart Plant in Troy, Ohio.

The Ohmite Company continues to expand its plant facilities.



Steel Fabricated on Site

Hobart Brothers, Troy, Ohio, has just completed a completely welded plant addition, 70 by 200 feet. Structural steel was fabricated in an adjoining building and moved a few feet to the building site by crane. "On the job" fabrication eliminated delivery delays so that the building was completed in a month and a half time. This fabrication became a simple matter through the use of modern cutting and welding equipment.

On-the-job welded fabrication is becoming quite popular because of the savings in both time and money it makes possible. Another advantage of this type of fabrication is that it helps relieve the crowded situation existing in steel fabricating shops.

» «

New Factory Addition

The **Ohmite Manufacturing Co.,** Chicago, manufacturers of quality rheostats, resistors, tap switches, and chokes, has recently completed an addition to the factory on West Flournoy Street in Chicago.

The enlarged plant doubles the production space and greatly expands the company's facilities. This current expansion is the second within a period of a few years.

» «

Display Building

Stoody Company, manufacturers of hard-facing alloys, grinders and other equipment, recently added another building to their plant in Whittier, Calif. The new building is to be used for demonstrating the application of various hard-facing alloys, for displaying various types of hard-faced equipment, and for showing educational pictures and slides. Occupying thirty-two hundred feet of floor space, the building is divided into five rooms which include a display Rotunda, a reception room, two interviewing offices and an auditorium and demonstration room.

One of the highlights of the building is the Rotunda. In this room the twelve walls serve as glass fronts for display cases in which examples of hard-faced equipment from many branches of industry are displayed. Along with each piece of equipment is a case history explaining the type of hard-facing used and how long the hard-faced parts lasted as compared to similar unprotected equipment.

The largest room in the building is the auditorium, which serves as projection room for showing pictures and slides of various hard-metal applications as well as a room for product display and hard-facing demonstrations. Hard-facing demonstrations are given in one of two booths in the front of the auditorium. One booth is for oxy-acetylene hard-facing demonstrations; the other for D.C. electric hard-facing demonstrations. Each booth is approximately fifteen feet across and is fully equipped. Pot glass windows between the welding booths and the auditorium enable the onlookers to watch demonstrations outside of the booths — away from the heat and smoke.

» «

The Rotunda of the Stoody Display Building.

Bastian-Blessing New Home

The **Bastian-Blessing Co.**, Chicago, manufacturers of RegO oxy-acetylene welding and cutting apparatus and RegO high pressure gas equipment, has moved into its new streamlined factory and home office at 4201 Peterson Ave.

The building covers 182,000 square feet on a single floor and has the departments so laid out that materials and operations simply flow without interruption from one end of the building to the other. The tract embraces 13 acres along a railroad line.

This model, daylight structure, streamlined in every detail and housing modern high-speed machinery, doubles the size and capacity of the company's former plant and offers unlimited technical facilities for continued improvement of product and service.

» «

A New Plant in Detroit

The **Electric Welding Machine Co.**, manufacturerers of arc and resistance welding equipment, have moved their headquarters and factory to a new building of modernistic design. The new location is at 9635 French Road, Detroit.

» «

Keystone's New Plant

The **Keystone Carbon Co.** has just completed a large addition to their factory in Saint Marys, Pa. The new wing will be used for the manufacture of brushes and porous bronze bearings. A considerable increase in production is predicted.

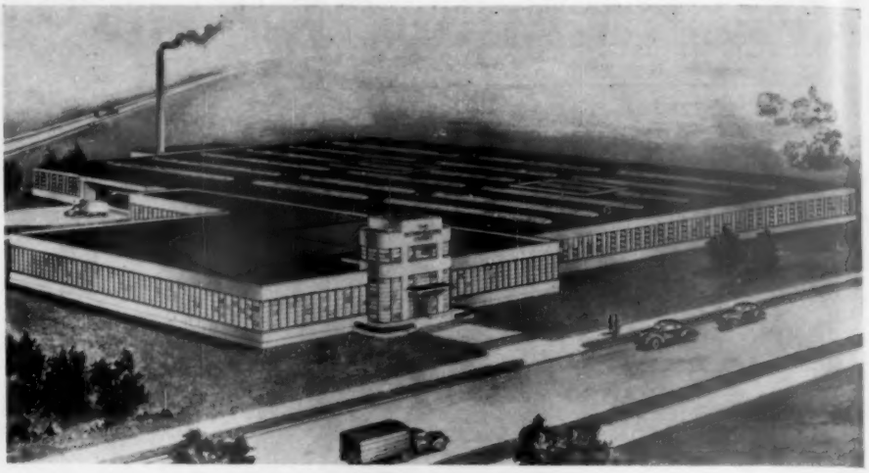
The company has also laid the foundation for another large plant addition which will house new equipment for making their negative temperature coefficient resistors.

» «

New Annealing Furnace

A modern, 24 ft. annealing furnace has recently been installed by **Joseph T. Ryerson & Son, Inc.**, for annealing their stock steel products after they have been flame cut. Usually it is not necessary to anneal after flame cutting. However, with some types of steel, occasionally in the case of plates, and in some situations this is desirable.

Though 24 ft. long, the furnace can be divided into three sections. Each of the three furnaces may be used as a separate unit, making possible an exceptionally prompt annealing service. The furnace, especially designed by Ryerson engineers, has a structural steel framework and is lined with a special heat resisting material. It is crane-served and so situated that steel to be annealed can be quickly transported to the furnace from any part of the huge Ryerson plant. The furnace is gas fired.



Bastian-Blessing move to Chicago's northwest side.

Another modern welding plant for Detroit.

Photo Allis-Chalmers Mfg. Co.

An all-welded rotary lime kiln.

170 ft. Lime Kiln

The recovery of lime presents quite a problem in the paper making industry. A Florida paper manufacturer, however, is attempting to minimize his difficulties by the addition of a huge rotary kiln to his processing equipment. The kiln installed was of all welded construction, 9 ft. in diameter and 170 ft. long.

News of the Industry

A.S.M.E. Fall Meeting

The **American Society of Mechanical Engineers** will hold their Fall Meeting at the Brown Hotel, Louisville, Oct. 12-15, 1941. A program of 35 papers on varied subjects have been arranged.

» «

Professional Engineers to Meet

The Fall Meeting of the **New York State Society of Professional Engineers** will be held in Niagara Falls, New York, October 24-25 with the Niagara County section in charge of the meeting. S. V. Jenkins, Professional Engineer of the Niagara Chapter, has been appointed chairman of the general committee. More than 300 Professional Engineers are expected to attend the sessions which will be keyed to the industry's all-out effort to speed defense. An interesting convention program has been arranged which includes several outside trips to places of technical and scenic interest.

» «

U. S. Civil Service Examination

Information Specialists—The U. S. Civil Service Commission has announced an examination for a specialist in press and publication and in radio. There are over 100 jobs to be filled in various government agencies with salaries ranging from $2600 to $4800 a year.

Applications must be on file with the Commission's in Washington office not later than October 23rd. Further information about the examination and application forms may be obtained from the Commission's representative at any first or second class post office or from the Central Office in Washington.

» «

Bridge Competition

The American Institute of Steel Construction have announced another annual bridge design competition, open to bona fide registered students of structural engineering and architecture in recognized technical schools of the United States and its possessions, and offers three cash prizes of $200, $100 and $50 respectively, for the designs placed first, second and third. Certificates, signed by the Jury of Award and Officers of the Institute, will be awarded to the prize winners and to those whose designs are given honorable mention. The premiated designs will become the property of the Institute.

A jury of nationally known engineers and architects will judge the competition on February 18, 1942. Drawings must be received at the Executive Offices of the **American Institute of Steel Construction,** 101 Park Avenue, New York City, not later than February 10, 1942.

Steel Engineers to Meet

The 1941 Annual Convention of the **American Institute of Steel Construction** will be held at The Greenbrier, White Sulphur Springs, West Virginia, October 14, 15, 16 and 17.

Trade News

The **Clifford A. Dobyn's and Co.,** manufacturers of Dobyn's Welding Rod for the welding of white metal have moved to new and larger quarters at 2417 North Ashland Ave., Chicago, so as to better be able to take care of the increased demand for their product.

» «

The **Induction Heating Corp.** announce their removal to larger quarters at 389 Lafayette St., New York. These new quarters which are 10 times the size of their previous location, have been made necessary by the increased amount of business resulting from defense production orders.

» «

The **Milburn Co.,** Detroit, manufacturers of Ply, announce the appointment of two new distributors.

In the New England Territory, **Otis Clapp & Son, Inc.,** of Boston, Mass. and Providence, R. I., have been selected as exclusive distributors for Ply products.

Farwell, Ozmun and Kirk Co., St. Paul, will represent Ply exclusively in the state of Minnesota.

Personals

B. M. Wolberg announces that he has resigned his position as sales manager for the Sellstrom Manufacturing Company of Chicago, and is now planning to take a well-earned vacation.

» «

At a recent directors' meeting of Union Carbide and Carbon Corp. **Fred H. Haggerson** was elected a director.

Mr. Haggerson is a vice-president of Union Carbide and Carbon Corporation; president of Union Carbide Company; and president of the companies in the Electro-Metallurgical group. Mr. Haggerson has been with the corporation for more than twenty years.

» «

The **Harris Calorific Co.,** Cleveland, Ohio, manufacturers of Gas Welding and Cutting Apparatus, have established a direct factory branch at 619 W. Washington Blvd., Chicago.

Lorn Campbell, president of the company, has announced the appointment of **H. D. North, Jr.** as Chicago Branch Manager. Mr. North is a graduate of Cornell University where he specialized in Mechanical Engineering. His continuous association with the Harris Calorific Company in various capacities gives him an excellent background for his appointment. In the past he has

"Why type for $4.00 a day when you can make $12.00 a day welding? It's fascinating, constructive and pays well," says Mrs. Louise Walsh Austad of Tucson, Ariz., when referring to arc welding in which she has been employed as an operator for five years.

Photo Lincoln Electric Co.

served as Field Representative and Factory Manager and broadened his experience considerably when in 1937 he accompanied Mr. Campbell on an inspection tour of leading Gas Welding and Cutting Apparatus factories in England, France and Germany, studying their methods of manufacture, application and selling.

This new branch with its factory-trained personnel will carry a full and complete stock of equipment and parts which will assure prompt and reliable service to all equipment users.

» «

On October 1st **Otto W. Winter** assumed the duties of vice-president in charge of manufacturing of the **Republic Drill and Tool Co.**, Chicago, newly organized manufacturers of high speed twist drills. He has also been elected a member of the Board of Directors of the Republic Company. For the past four years, Mr. Winter has served as factory manager of the Columbus McKinnon Chain Corp. and its subsidiary, Chisholm Moore Hoist Corp., Tonawanda, N. Y. He is a member of the American Welding Society as well as several other technical groups.

» «

D. W. R. Morgan, George P. Passmore, and **A. P. Craig** will supervise increased expansion and production activities in the Westinghouse Electric and Manufacturing Co. South Philadelphia works. These new appointments were announced by R. A. McCarty, Vice President.

Mr. Morgan will direct over-all manufacturing operation, both in the South Philadelphia works and the new merchant ship equipment shops.

Mr. Passmore becomes manager of the industrial relations department. A major portion of his new duties will be concerned with securing new employes, and co-operating with the manufacturing department in the plant's extensive training program, while Mr. Craig, as Assistant to the Vice-President, will be responsible for co-ordinating the work of all Company departments in building and equipping the merchant ship factory buildings.

» «

Carnegie-Illinois Steel Corp. announced the appointment of **Paul F. Vander Lippe** as assistant to the manager of sales in charge of the Kansas City office. He succeeds **Howard J. Mullin** who was recently transferred to Detroit.

Mr. Vander Lippe began his business career at the St. Louis district sales office of the former Carnegie Steel company on April 1, 1911. He became a salesman on July 1, 1922 and on November 1, 1935 was transferred to the Tulsa office as resident salesman for Carnegie-Illinois Steel corporation.

» «

R. J. Forkey has been appointed sales engineer for upper and western New York state by **Norton Co.**, Worcester, Mass. Mr. Forkey, a graduate of Worcester Polytechnic Institute, has been connected with the research laboratories and the sales engineering department at the Worcester plant.

» «

After forty-eight years of service with **American Steel & Wire Co., Daniel Lynch** is retiring as superintendent of the company's Rockdale works at Joliet, Ill. He will be succeeded by **John P. Debri,** general superintendent's clerk, Joliet works.

» «

Sixty-three veteran employees of the Joliet plants of **American Steel and Wire Co.** were awarded United States Steel Corp. service medals September 24, at a dinner in their honor at the Woodruff hotel in Joliet. The service of the men ranged from 25 to 50 years and represented a combined total of 1995 years.

F. Ingraham, Chicago district manager of the Wire company presented a 50-year gold medal to **F. J. Whitgrove,** former superintendent of the DeKalb works, a 45-year medal to **James Darrow,** general superintendent of Joliet works, and a 30-year medal to **George H. Bendell,** assistant general superintendent of Joliet works. The remainder of the medals were presented by Mr. Darrow.

Medal distribution was as follows: one 50-year medal, one 45-year medal, seven

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Longer Life . . .
Fast Cutting . . . .
Reordered . . . . .

In this quotation taken from a trial report, typical of hundreds in our files, is the whole story of Cortland Weld Grinding Performance in a nut shell.

"Longer life than competitive wheel", in this case 50%,—there's maximum wheel life!

"Fast cutting"—there's proof that lasting qualities were not obtained by sacrificing efficiency.

"Reordered"—there's satisfaction!

The records speak for themselves.

There is a Cortland distributor in your neighborhood. He can help you reduce your grinding costs.

CORTLAND GRINDING WHEELS CORPORATION
CHESTER, MASS.

40-year medals, twenty 35-year medals, fourteen 30-year medals, and twenty 25-year medals.

» «

Glenn L. Martin, president of The Glenn L. Martin Co., announced the appointments of four important executives for The Glenn L. Martin-Nebraska Company, the new wholly-owned subsidiary which will operate the new aircraft assembly plant at Omaha, Neb.

Herman G. Klemm, executive engineer of the Martin company, has been named chief engineer of the western company; **William O. MacArthur,** formerly of the firm of Joseph Froggatt Company, certified public accountants, of Boston, is the comptroller; **Harry M. Shealey,** assistant factory superintendent in charge of the Canton Division of the Martin company, is factory superintendent of the new compay, and **Carl B. Hamlin,** chief inspector at Middle River, becomes chief inspector at Omaha.

» «

J. L. Holloway was elected a vice-president of **Crane Co.,** in charge of finance, at a recent meeting of the Board of Directors.

Mr. Holloway joined the Crane organization in 1935, was elected secretary of the company in 1937 and, in addition, was appointed assistant to the president in 1940, which positions he held until his election as vice-president.

At the same meeting of the Board, **W. H. Winslow, Jr.** was elected secretary. He joined the Crane organization in 1939 to handle tax and legal matters for the company, and has been assistant secretary since early in 1940.

» «

O. J. Pearre has been named arc welding specialist in the General Electric Philadelphia district office, according to an announcement by **W. J. Dorworth,** manager of the Philadelphia Industrial Department. Mr. Pearre succeeds **W. A. Terry,** recently transferred to general sales work.

A native of Baltimore, Maryland, Mr. Pearre was graduated from Lehigh University in 1931 with a Bachelor of Science degree in Mechanical Engineering. At that time he entered the General Electric Company on its test course, later being transferred to Philadelphia to work with S. S. Fretz, G-E's Philadelphia air conditioning distributor.

In his new capacity, Mr. Pearre will have charge of G-E electric welding sales along the Atlantic seaboard, including the heavy industrial centers of Philadelphia, Norfolk, and Pittsburgh. In this area, electric welding has rapidly assumed a new importance because of the use of this means of fabrication in shipbuilding yards and ordnance plants.

» «

Ernest P. Moslo, president of **Moslo Machinery, Inc.,** 4516 Superior Ave., Cleveland, announces the appointment of **Paul M. Janko** as Sales Manager.

Mr. Janko has been covering the Pittsburgh area for the company and will continue to serve his friends and customers at frequent intervals. He will, in addition, work with other salesmen of the company and with the Home Office in Cleveland.

A new member was recently added to the Moslo Staff—that of **R. C. Burton.** Mr. Burton will direct the Advertising and Sales Promotional activities of the company.

» «

Obituary

Thomas H. Jones, 58, one time Chairman of the Chicago Section of the American Welding Society and a well-known welding figure throughout the middle-west died Sept. 15. Mr. Jones was born in South Chicago and in 1907 became employed at the Carnegie-Illinois Steel Company South Works as a boiler maker. During his course of employment, he advanced in various positions in the boiler shop, eventually becoming foreman. Then in 1928 he became a welding foreman. In 1936 Mr. Jones became general foreman of the South Works welding shop.

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American industry is entering upon a great program of national defense. Thousands of new workers are being trained in every field, workers who will be the very foundation of this tremendous industrial expansion. Conserve this very important man-power by providing the maximum in protection for their eyes.
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. . . THERE IS NO BETTER
Within the covers of this 36 page catalog is an extensive range of modern protective equipment, practically designed and carefully made, for wide industrial use. A copy in your permanent file will be of invaluable assistance in solving your safety problems.
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INDUSTRIAL GOGGLES
WELDERS HELMETS
WELDERS HAND SHIELDS
PROTECTIVE LENS

Mr. Jones was an active worker in welding and the activities of the Welding Society. However, his time was not entirely devoted to welding and he was well-known in his community as one who devoted considerable energy to humanitarian causes, being active in Y.M.C.A., church and fraternal order activities.

» «

Harold J. Stein, 47, director of research, chemistry and metallurgy at the Allis-Chalmers Mfg. Co. since 1939, died September 9. Mr. Stein came to Allis-Chalmers as a student apprentice in 1916, served in various manufacturing departments and was in turn made general foreman of the company's heat treating operations, assistant foreman of the forge department and later a research engineer. In 1936 he was made chief research engineer of all the manufacturing departments of Allis-Chalmers.

Mr. Stein was born in Philadelphia, Pa., the son of Joseph Stein, superintendent of the experimental station at the naval academy, Annapolis. He attended Tri-State college at Angola, Ind. For many years he had been a member of the American Society of Testing Materials, the American Foundrymens' Association and the American Society of Metals, the Milwaukee chapter of which he was instrumental in founding.

FOR BIG JOBS THAT DEMAND THE BEST...
BRIDGEPORT BRONZE WELDING RODS
"EQUAL TO ANY JOB... WORTHY OF YOUR SKILL..."
For lasting, quality welds, the rod you select is of primary importance. For it must be pure, reliable, uniform and workable . . . rod that builds up strong, dense and tough, on all cast iron, steel or bronze work.
The distinctive quality characteristics of Bridgeport Bronze Welding Rod will show up as outstanding results in the work you do. For Bridgeport builds top quality into every inch of Bridgeport Bronze Welding Rod. The ways and means to get the best results in bronze welding of Bridgeport rod are clearly presented and illustrated in Bridgeport's new Manual on Bronze Welding Alloys. It's FREE, and you may get your copy by writing to
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Trade Literature

Positioner Bulletin

The Industrial Div., **Ransome Concrete Machinery Co.**, Dunellen, N. J., have released a new 12 page bulletin No. 188 covering the complete line of **Ransome Welding Positioners** from the 2000 lb. capacity hand-operated to the 8 ton heavy duty motor operated unit. Included in this booklet are many interesting application pictures.

» «

Welding Cable Leaflet

FlexArc welding cable for work leads and electrode holders is described in a new leaflet announced by Westinghouse Electric and Manufacturing Co. Flexibility, durability, and other features are included in the general discussion. The application of electrode holder cables are described with a note on their construction.

A tabulation gives welding currents of from 50 to 700 amperes and voltage drop per 100 feet for cable sizes of from 3 to 4/0. Use of the table is explained by tracing the procedure involved in solving a typical welding cable selection problem. The cable is offered in two sizes; the smaller to cover a range up to 300 amperes, the larger for current values above 300 amperes. The uses for the two sizes are explained.

List prices, quantity discounts, delivery and terms are given. A copy of catalog section 26-630 may be secured from department 7-N-20, **Westinghouse Electric and Manufacturing Co.**, East Pittsburgh, Pa.

» «

Positioner Booklet

Just off the press is an interesting illustrated booklet known as **Bulletin SL 21** which describes C-F Sheet Lifters, a product of the **Cullen-Friestedt Co.**, 1309 S. Kilbourn Ave., Chicago, Ill. These modern machines for lifting and carrying sheet steel and other hard to handle material are widely used for speed and economy where loads from 2 tons to 60 ton or larger, must be moved with maximum safety to men and materials. Many varied applications of C-F Lifters are shown with photographs of machines of various capacity—all under "one-man" positive control which provides infinite adjustment to load.

Bulletin SL-21 will be gladly sent without obligation to those interested by addressing the Cullen-Friestedt Co.

» «

Welding Bulletin

The **A-C Devices Co.**, 912 W. Van Buren St., Chicago, have released a 4 page bulletin on the **"Cold-Arc Ionizer."**

This bulletin describes a new high frequency unit which may be connected in the circuit of an A-C welder, converting the welding current into high frequency current. In the bulletin it is pointed out how through the use of the Cold-Arc Ionizer it is possible to weld alloys and non-ferrous materials with an A-C welder.

Nickel Alloy Catalog

"Individualized Inco Nickel Alloys"—a twelve-page catalog giving individual characteristics, mechanical properties and application information on the Inco Nickel Alloys — Monel, "K" Monel, "KR" Monel, "S" Monel, "R" Monel, Nickel, "Z" Nickel and Inconel. Tables of physical constants and available forms are included. Copies are available upon request from the **International Nickel Co., Inc.**, New York.

» «

Rust Proofing Data

Galv-Weld, Inc., Dayton, Ohio, manufacturers of a re-galvanizing process and materials, have issued a brochure on the **Galv-Weld Process** for the purpose of obtaining licenses to use this re-galvanizing process. **Eagle Pitcher Lead Co.**, Cincinnati, is exclusive manufacturer of Galv-Weld material for the distribution to licensed users of the Galv-Weld process.

» «

Machine Tool Catalog

A new and completely revised catalog illustrated, 56 pages has been issued by the **Walker-Turner Co., Inc.**, Plainfield, N. J. It explains in detail the standard line of metal working and wood working machine tools made by this company.

Also shown are a number of entirely new machine tools developed primarily for the defense industries. A post-card addressed to the Walker-Turner Co., Inc., South Ave., Plainfield, N. J. will bring a copy of this catalog to your desk.

» «

Defense Booklet

"Steel for Defense" is the title of a 24 page booklet recently released by the **American Iron and Steel Institute**, New York City.

This booklet tells of the work that the steel industry is doing in the defense program and how steel is used in practically all of the defense forces, those of land, sea and air. Steel is portrayed as playing an important part in our national defense "behind the lines". Included as a part of this bulletin are 5 pages of questions and answers about steel in defense.

» «

Welding Catalog

In a new 38 page catalog entitled **"Hobart Simplified Arc Welding"** recently released by the **Hobart Bros. Co.**, Troy, Ohio, there is pictorially displayed the complete Hobart line of welders, welding accessories and electrodes.

In this profusely illustrated catalog there are pointed out the distinctive features of the Hobart machine as well as pictorial examples of many jobs on which Hobart equipment has been employed. There is also included a brief description of the Hobart trade school.

Alloy Data Book

"New Technical Data Book" is the title of a 32 page booklet describing the new Castolin Welding Alloys and answering about 200 questions concerning low temperature welding. This is a booklet that would be of extreme interest to weldors and shop men engaged in low temperature brazing. Copies may be had upon request by addressing **Eutectic Welding Alloys, Inc.**, 40 Worth St., New York, N. Y.

» «

Welder Bulletin

In a 4 page bulletin, **W-28-1**, the **Harnischfeger Corp.**, Milwaukee, Wis., describe the P & H-Hansen Type WE-150 Square Frame Welder. It is pointed out how these welders may be conveniently stacked and parallelled for multiple operator operation.

» «

Synthetic Rubber

"Properties of Ameripol D" is the title of an 8 page bulletin recently released by **B. F. Goodrich Co.**, Akron, Ohio. This bulletin, besides picturing many examples of the present day use of Ameripol D, features 4 tables showing the comparative properties of synthetic rubbers, the effects of various materials on synthetic rubbers, typical Ameripol D vulcanizing compounds and the effects of emersion in various solutions upon this material.

ALUMINUM BRONZE WELDS
Lick the Tough Jobs

AMPCO-TRODE
THE Only COATED ALUMINUM BRONZE WELDING ROD

SUITABLE FOR WELDS OF ALL TYPES . . .

Rods from 1/8" to 1/2" in diameter—and in six grades of strength, from 50,000 to 80,000 p.s.i., and hardness from 100 to 387 Brinell — easily used with metallic arc, carbon arc or oxy-acetylene processes, on all steel, cast iron, brass, bronze, and nickel alloys.

NOW try AMPCO-TRODE — the new welding rod with the remarkable properties of AMPCO METAL. This unique alloy of the aluminum bronze class has become recognized throughout industry for its outstanding strength and hardness, its resistance to wear and corrosion. Now it's available for welding. Use it for overlaying steel and cast iron — for building up shafts, wear strips and large forming dies — for welding brass and bronze — for a host of purposes where service conditions are severe.

AMPCO METAL, INC.
Dept. WR-10 Milwaukee, Wis.

GET COMPLETE DATA

Write for new bulletin giving full details of physical properties and applications of AMPCO-TRODE. Our engineers are at your service.

AMPCO-TRODE
A product of
AMPCO METAL
The Metal Without An Equal
AMPCO

Engineering Data Sheets

The interest of design engineers and metallurgists in the monthly **Engineering Data Sheets** distributed by **Ampco Metal, Inc.,** Milwaukee, Wis., has led to the publication of a selection of the most pertinent of these in a 56-page booklet. A wide range of subjects has been covered, and care has been taken to eliminate material duplicated in other Ampco literature.

Since the first data sheet was published in 1934 and others have been issued monthly, the new booklet contains the cream of an extensive collection of engineering material on Ampco Metal, an alloy of the aluminum bronze class and other aluminum bronzes.

Copies of new booklet will be sent on request to metallurgists and designing engineers interested in alloys of this nature.

» «

Resistance Welding Bulletin

The Resistance Welding Manufacturers' Association Bulletin No. 6 is entitled **"Electro Brazing Methods."** This bulletin is a 7 page reprint from the October, 1940 issue of the Welding Journal and is a paper presented by R. J. Wensley at the annual meeting of the American Welding Society, Cleveland, 1940.

WELDING POSITIONER

AN 18 TON CAPACITY POSITIONER
ROTATES 360°—TILTS 90° from HORIZONTAL
TABLE DIAMETER 13' 11"

Manufactured by

MISSISSIPPI VALLEY STRUCTURAL STEEL CO.

MELROSE PARK, ILL.

Machinery & Welder Corporation, Sales Agents

CHICAGO—ST. LOUIS—MILWAUKEE—MOLINE

Ampco Bulletins

Ampco Metal, Inc., Milwaukee, are distributing two new bulletins covering "Ampco Metal in Aircraft" and "Ampco Metal in Acid Resistant Service." These are letterhead size, six pages, and well illustrated.

"Ampco Metal in Aircraft" discusses the growing use of aluminum bronze by the aviation industry, contains a diagram of a typical plane indicating the numerous parts made of Ampco Metal, and gives a comprehensive table of aircraft specifications met by Ampco-made bronzes.

"Ampco Metal in Acid Resistant Service" describes the ability of Ampco Metal to resist acid and corrosion, and shows the importance of Ampco-made bronzes in this field. The bulletin is well-illustrated with views of parts used in acid-resistant service.

Copies of the new bulletins will be sent on request to those interested in these services.

» «

Welder Bulletin

Flexarc a-c welders for every type of welding job ranging from light gauge sheet to sustained, heavy duty industrial fabrication are described in a new 8-page bulletin announced by Westinghouse Electric and Manufacturing Co. Current ranges of these welders are from 20 to 625 amperes.

Improvements in a-c welder construction are discussed with a note on new type electrodes. Hints on the selection of a-c welding equipment include descriptions and ratings of the units. The bulletin is well illustrated to make explanations of the welder parts easy to follow.

A copy of bulletin **B-2285** may be secured from department 7-N-20, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

» «

Welding Cost Booklet

Cost of arc welding electrodes can now be estimated rapidly for welding any type of joint on any thickness with either bare or coated electrodes by the use of the new Airco **"Electrode Consumption Calculator."** Recently published by Air Reduction Sales Co., this booklet tells how many pounds of electrodes are required per linear foot of weld. The calculator includes consumption figures for both bare and shielded arc electrodes on all metal thicknesses commonly employed in making fillet welds, square groove butt joints, "V" and "U" groove butt joints, bevel grooves and "J" grooves. The amount of steel deposited per linear foot of weld is also shown. As a further aid on other joints not shown, the basic formulas used in these calculations are included.

Copies of the new Airco "Electrode Consumption Calculator" can be obtained by writing to **Air Reduction,** 60 East 42nd Street, New York, N. Y.

Welding School Booklet

A new pictorial booklet **"You And Your Job In Arc Welding"** has just been published by the **Hobart Trade School, Inc.,** Troy, Ohio. The functions and courses of study pursued at the school are explained in this 12 page publication which may be obtained free of charge by writing the Registrar of the school.

» «

Motor Generator Bulletin

Motor Generator Corp. Troy, Ohio has just published a pamphlet describing their latest models of motor generator sets, electroplating sets, and anodizing sets. Copies of the publication may be obtained free of charge by writing the company.

» «

Seam Welder Bulletin

Roller Seam Welders is the title of a bulletin recently released by the **Taylor-Winfield Corp.,** Warren, Ohio. This bulletin lists and describes standard line of Taylor-Winfield Seam Welders, as well as giving certain worthwhile information on Seam Welders.

» «

Resistance Welding Bulletin

Bulletin No. 5 of the **Resistance Welder Manufacturer's Assn.** is entitled "Resistance Flash Welding of Strip in Steel Mills." This is a 12-page reprint of a paper by J. H. Cooper, which was presented at the 21st Annual A.W.S. Meeting in Cleveland.

» «

Instruments Bulletin

Miniature a-c and d-c voltmeters and ammeters in the two inch classification for general use are described in a new 12-page bulletin announced by Westinghouse Electric and Manufacturing Co.

Typical instruments are illustrated and cutaway views show construction details. A complete tabulation lists ratings, scale divisions, style numbers and list prices.

A copy of catalog **section 43-330** may be secured from department 7-N-20, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

» «

Alloy Bronze Catalog

Ampco Metal, Inc., Milwaukee, Wis., have issued a catalog describing their **Ampcoloy** series of bronzes. This new book contains descriptions of the alloys and a comprehensive table of physical properties and range of chemical compositions.

Among the Ampcoloy series are alloys of aluminum bronze, manganese bronze, beryllium-copper, high-conductivity, and high-lead alloys. Many government specifications for Federal, Air Corps, and Navy use are listed.

Electrode Bulletin

The **General Electric Co.,** Schenectady, N. Y., has issued a 2 page bulletin which gives complete information on the G-E Type W-83 electrode for the welding of cast iron. This publication is known as bulletin **GEA-3493.**

» «

Welding Handbook

A revised twenty page handbook of welding electrodes and accessories has been issued by the **Hobart Brothers Co.** Copies of this publication may be obtained by requesting from Hobart Bros. Co., Box EW-79, Troy, Ohio.

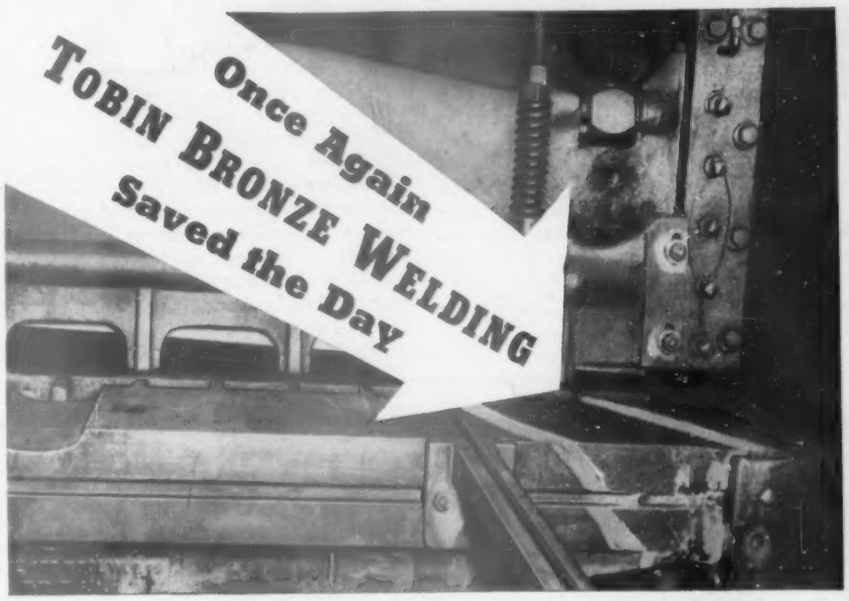
Aluminum Bronze Bulletins

Ampco Metal, Inc., Milwaukee, Wis., has published two new bulletins.

"Ampco Metal in Gears" discusses the use of Ampco Metal in gear applications. The bulletin shows case histories, contains a chart showing physical properties of grades of Ampco best-suited for gear service, and lists typical users.

"Ampco Metal in Heavy Machinery" emphasizes the use of Ampco Metal in this field, where shock, impact, and severe wear must be overcome by a wise selection of material. A diagram shows the application of Ampco Metal in typical road building equipment.

Copies of these 6-page bulletins will be sent to interested engineers.



A LARGE steel warehouse, Brown-Wales Co., Boston, was busy rushing out defense orders, when a casting of a vital 4-ton plate shear suddenly let go. Many shipments were held up by the fracture—two feet across one leg and eighteen inches up the bed plate. It was out of the question to wait for a new casting.

A difficult situation to be sure, but the Industrial Welding Company of South Boston, Mass., saved the day by welding the fracture with Tobin Bronze. Using 126 pounds of Tobin Bronze Rod, 1500 feet of oxygen and 800 feet of acetylene, they repaired the shear in twenty-four hours — six hours for preparation and eighteen hours of actual welding time.

Should you ever be faced with a similar emergency, bear this story in mind. It is typical of how Tobin Bronze welding has salvaged countless pieces of expensive equipment, seemingly damaged beyond repair. And remember, too, not only does Tobin Bronze make strong, sound welds, but because of its low melting point, its use effects large savings in pre-heating time and fuel consumption. The trademark "Tobin Bronze Reg. U. S. Pat. Off." is stamped on every Tobin Rod. Look for it and be sure you get the genuine

41138

ANACONDA *Anaconda Welding Rods*

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

Civilian Defense

The U. S. **Office of Civilian Defense,** Washington, D. C., recently released a 36 page pamphlet entitled **"A Civilian Defense Volunteer Office."** The purpose of this publication is to point out the purpose of civilian defense volunteer offices, how to set them up and organize them for efficient operation as well as telling what is the functions of the office.

"Civilian Protection" is the title of another booklet recently issued by the **Office of Civilian Defense.** This publication tells the duties of various groups assigned to defense service, as well as illustrating the arm insignias to be worn by those who volunteer for service in civilian defense groups.

» «

Press Bulletin

Steelweld Machinery Div. has issued a 4 page catalog on **Steelweld Bending Presses** which describes construction details, gives sizes and dimensions. There are also drawings illustrating many of the bends which can be made by these presses.

A section is also devoted to the Steelweld bulldozers which are built for heavy work such as experienced in forge shops where tremendous power is necessary. Information on the Steelweld presses may be obtained from the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

Hard-Facing Bulletin

"Amsco Welding Products" is the title of a 12 page bulletin recently released by the American Manganese Steel Div., Chicago Heights, Ill. In this bulletin there is pointed out the many ways in which Amsco welded metals are being used to reduce wear and consequently reduce maintenance costs of equipment in many industries.

Two pages of the bulletin are devoted to hard-facing applications of the electric arc and acetylene methods in various industries making recommendations as to the correct hard-facing material to use on a particular item of equipment.

» «

Wire Rope Safety Booklet

The **Hazard Wire Rope Division** of the American Chain & Cable Company, Inc., has recently issued a 24 page booklet on the safe use of wire rope. Not only does this new booklet give tables of breaking strengths for all commonly used rope constructions, together with safety factors for the principal rope applications, but it offers constructive information on the effects of acceleration, the various constructions and grades of wire rope, and suggestions for the correction of operating factors affecting safety such as abrasion, bending fatigue, reverse bends, kinking, spooling, crushing and corrosion.

Diesel Application Booklet

What Users Say About "Caterpillar" Diesel Power, a new booklet published by **Caterpillar Tractor Co.,** Peoria, Illinois, has unusual value and interest.

Problems solved by application of Diesel power are discussed, and installations portrayed. The book deals with irrigation, mining, cotton ginning, powering sawmills, milling flour, lighting construction jobs, drilling, feed milling, lumber finishing, poultry hatchery, construction equipment, ice and refrigeration, Marine Engine, heavy-duty hauling, sand, gravel and crushed rock, shovel, creamery, oil pumping, hammer mill, machine shop and locomotive.

In requesting copies of this booklet ask for Form 6636.

Recent Patents

Electrode and Holder

2,254,696. **Ralph A. Gilbert,** Pittsfield, Mass., assigned to **General Electric Co.,** of New York. Filed June 18, 1940. Issued Sept. 2, 1941. In certain manufacturing operations, it is frequently necessary in order to obtain a desired assembly to attach to a supporting member by resistance spot welding a plurality of parts of different shape. Since each part to be welded may require an electrode having a work engaging sur-

At the National Metal Show
Philadelphia, Pa., Oct. 20-25, 1941

BOOTH B-17

See these

Ransome

Welding Positioners

IN ACTION!

Let us give you helpful suggestions on how to:

- SAVE up to 50% of welding costs.
- INCREASE welding production up to 50%.
- PRODUCE better stronger welds.
- REDUCE accident hazards and crane service.

If you can't attend the show we'll be glad to send you literature and complete information on these and other sizes.

Industrial Division

RANSOME CONCRETE MACHINERY COMPANY
DUNELLEN NEW JERSEY

face portion conforming in configuration to the shape of the work part welded thereby, it has been the practice to use either a number of separate welding machines; or one machine has been used for a number of similar parts. It has also been proposed to change welding electrodes between the welding operations. The patent describes a quick-change electrode connected by a plug and socket joint to a support. The joint is yielding in one direction under the influence of the welding pressure and is separable in the opposite direction. A braid-wire inserted between the holder and the electrodes serves to transmit current to the electrode.

» «

Welding Timer

2,253,370. **Otto Eisenschmid,** Berlin, Germany, assigned to **Westinghouse Electric & Mfg. Co.,** Pittsburgh, Pa. Filed Dec. 17, 1938. Issued Aug. 19, 1941. A short-time circuit breaker useful for resistance spot welding is described. Imperfect spot welds are stated to be caused by an excess of current. Control of potential improves the welds.

» «

Portable Welder

2,253,403. **Emil F. Steinert,** Sharon, Pa., assigned to **Westinghouse Electric & Mfg. Co.,** Pittsburgh, Pa. Filed Feb. 4, 1939. Issued Aug. 19, 1941. An alternating current arc welding transformer reactor power unit is mounted on a wheeled base member. There is also a partitioned housing having a lower ventilated compartment for enclosing the power unit and an upper compartment for the accommodation of the necessary welding accessories.

» «

Welding Machine

2,253,702. **Preston M. Hall,** Worcester, Mass. Filed June 8, 1940. Issued Aug. 26, 1941. This invention relates to welding machines of the type in which one of the electrodes is mounted for manual movement toward and from welding position. An improved support for the movable electrode and for supplying yielding pressure to that electrode is described. The manual operation is carried out with a foot lever pivoted so as to move a sliding stand for the movable electrode.

» «

Welding Thin Strips

2,253,709. **Lorenz Iversen,** Pittsburgh, Pa., assigned to **Mesta Machine Co.,** Pittsburgh, Pa. Filed April 29, 1940. Issued Aug. 26, 1941. The method of flash welding long, thin, flat pieces of metal which comprises disposing the ends of the pieces in non-parallel relation while maintaining the axes of the pieces alined and their sides parallel for a great portion of their length at least, abutting the ends at one side of the pieces and passing electric current between the ends while maintaining the alinement of the pieces and the parallelism of their sides for a great portion of their length. Then the push-up of the pieces is controlled as the ends are heated to welding temperature so as progressively to produce a line flash-weld between the ends, and so that when the weld is completed, the sides of the connected pieces will be substantially parallel.

» «

Welding Rod

2,253,812. **Robert M. Rooke,** Jersey City, N. J., and **Frederick C. Saacke,** Astoria, N. Y., assigned to **Air Reduction Co.,** of New York. Filed Feb. 6, 1940. Issued Aug. 26, 1941. For the oxy-acetylene welding of carbon-molybdenum alloy steel a rod having the following composition is used: An iron alloy containing carbon .02% to .30%, manganese .10% to 1.50%, silicon .05% to .40%, and molybdenum .20% to 1.00%, and free of consequential amounts of chromium. Welds made with this rod show creep rates no higher than the base metal. This property is valuable in the welding of high pressure vessels or pipes.

» «

Welding Torch

2,253,994. **Clarence I. Barclift,** Daytona Beach, Fla. Filed April 9, 1940. Issued Aug. 26, 1941. An electric welding torch which includes a handle with two conducting bars. One of the conducting

The Improved SIMPLEX Electrode Holders

Practical—Economical—Light

WEIGHT 15 OZ. EACH 1/16" to 1/4" ELECTRODES

STYLE "S" (Soldered Connection)

Jaws of heavy copper alloy of sufficient current capacity and strength to withstand duties of its class. Sturdy compression spring supported by heat resisting insulating seats. Current can not pass through spring. Insulating fibre handle permits firm balanced grip. STYLE "S" (Soldered connection) has rear end of fixed jaw cored to receive cable, insulating handle covers connection. STYLE "R" (removeable connection) carries cable to a point ahead of handle where it is firmly clamped to prevent heating. Unnecessary to divide or rearrange cable strands.

Send for large, profusely-illustrated Catalog No. 20.

Style "R" (Removeable Connection)

Distributors In All Principal Cities

THE FIBRE-METAL PRODUCTS CO. CHESTER, PENNA.

HAVE YOU SEEN?

The Facts and Figures?

The Data Sheets?

The Welding Story?

If you haven't, you haven't visited

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A visit may win you a *Welding Encyclopedia,* too!

bars is slidably mounted in the handle in parallel relation to the other bar. Each bar has an electrode gripping unit at its outer end. The movable bar is controlled by a thumb piece which actuates the bar through a bell-crank lever.

» «

Welding Silicon Steel

2,254,314. **Eo Reed,** Zanesville, Ohio, assigned to The **American Rolling Mill Co.,** Middletown, Ohio. Filed May 6, 1939. Issued Sept. 2, 1941. In the practice of this invention, sheet materials to be welded are placed on a table having guide means. With the sheet edge held against the guide means the end of each sheet is sheared by a mechanism including a magnetic hold down which clamps the end of the sheet under a force effective over a desired area. All ends of the sheets to be joined are sheared under identical conditions of clamping area and pressure. This permits proper welding even though the sheets are characterized by considerable waviness and lack of flatness.

» «

Roll Welding Electrode

2,254,657. **Lorenzo Kennon,** Burbank, Calif., assigned to **Lockheed Aircraft Corp.,** Burbank, Calif. Filed May 13, 1940. Issued Sept. 2, 1941. A contact roll for electric resistance welding machines includes a ring member forming the contacting surface. The ring member is supported by a unit having a peripheral passage for a cooling fluid, the passage being partly defined by the ring. Forced circulation of cooling fluid for supply and discharge is provided to the peripheral passage.

» «

Welding Electrode

2,250,645. **Joseph W. Meadowcroft** and **Chester Scull,** Philadelphia, Pa., assigned to **Edward G. Budd Mfg. Co.,** of Pennsylvania. Filed July 27, 1938. Issued July 29, 1941. The patent points out that the customary practice of making electrode tips has involved the forming of the tips by machining from hardened cylindrical copper or copper alloy stock. Since the tips are necessarily hollow for the circulation of cooling fluid, considerable material must be cut or drilled away and wasted by this method. And, further, copper is liable to be heated and annealed to some extent by the cutting, thereby producing a tip of insufficient hardness. The patent describes a method of making a tip by drawing flat stock through dies. The invention also hardens the contact tip which may be of the cold forged or machined type. The new tip has long wearing qualities, and is capable of having its head hardened by cold working while the tip is made. The method involves drawing from a flat disc of copper a head and sleeve portion in a plurality of stages, annealing the blank prior to the last drawing stage, and hammering the head portion axially thereafter to increase the hardness.

» «

Welding Rails

2,250,869. **George L. Jones,** Garden City, N. Y., and **Charles B. Roede,** Ridgefield, N. J., assigned to **Sperry Products, Inc.,** Brooklyn, N. Y. Filed Oct. 15, 1937. Issued July 29, 1941. This invention relates to a rail welding machine which is mobile and which is capable of travelling under its own tractive power and generating the power necessary for the welding operation. The machine is a train which provides everything that is necessary for the manufacture of welded rail in quantity at points nearest to the points where such rails will be laid in track, thus cutting down to a minimum the distances through which the rails must be shipped before being laid in track. An ordinary steam locomotive is employed for the combined tractive power and welding power generating units. A single continuous rail can be fed off the end of the welding train directly on to the ground either into track or adjacent the track where the rail is to be laid. Control of heat, grinding, shearing, and other essential operations, is disclosed.

» «

Multiple Circuit System

2,254,882. **John H. Blankenbuehler,** Edgewood, Pa., assigned to **Westinghouse Electric & Mfg. Co.,** Pittsburgh,

ARE YOU SAVING STEEL?
DON'T SCRAP WORN EQUIPMENT
Repair with
MANGANAL
(Reg. U. S. Pat. Office. U. S. Patents 1,876,738—1,947,167—1,021,945)
11 to 13½% Manganese Nickel Steel
WELDING ELECTRODES
Bare, Standard and Special Tite-Kote
APPLICATOR BARS
Round, Square, Flat, Special Shape
Hot Rolled Plates. Cast Wedge Bars.
Write for descriptive circulars and name of nearest distributor.
STULZ-SICKLES CO. Sole Producers 91 N. J. Railroad Avenue, NEWARK, N. J.

The Improved "Round File" Gas Lighter
Locking "Slip-on" Renewal
—an exclusive feature

The patented cartridge holding the spark metal locks exactly in correct position, permitting instant replacement.
Get acquainted with the many other superior, exclusive features of Improved "Round File."
Circulars and prices on request.
SAFETY GAS LIGHTER CO. (Est. 1901) LYNN, MASS.

Pa. Filed Feb. 29, 1940. Issued Sept. 2, 1941. An object of this invention is to connect a plurality of welding circuits to a single source of welding current and provide for maintaining substantially constant circuit conditions in at least one of the circuits when another of the circuits is energized or deenergized. Automatic control of the output conditions of a generator is also provided to maintain predetermined current conditions in the welding circuits.

» «

Arc Welder

2,255,141. **Robert E. Weir,** Chicago, Ill., assigned to **Robert L. Kahn,** Chicago, Ill. Filed Aug. 2, 1940. Issued Sept. 9, 1941. A welder including a source of single phase alternating current, a full wave rectifier connected to the current source and having output terminals, and a condenser input filter section connected across the output terminals. The section has a condenser across the input. The system described is particularly suited for arcs of less than 200 amperes.

» «

Use of Resins

2,250,940. **Erwin A. Zahn,** Guilderland Center, and **James R. Patterson,** Scotia, N. Y., assigned to General Electric Co., of New York. Filed May 26, 1939. Issued July 29, 1941. Surfaces of parts to be welded are first coated with a heat hardenable synthetic resin-oil varnish composition containing as the synthetic resin component one or more resins selected from the class of phenolic resins and alkyd resins. The coated parts are then welded.

» «

Electrode Holder

2,251,779. **Philip Bourque,** Detroit, Mich., assigned to **Bordon Mfg. Co., Inc.,** Detroit, Mich. Filed May 6, 1940. Issued Aug. 5, 1941. The object of the invention is a holder which is simple in structure, economical of manufacture, durable, compact, light, non-rattling, highly efficient in use and one in which heating of the handle will be reduced to a minimum. The holder has a pair of jaw forming plates which are secured together at one of their ends and which are adapted to be sprung apart at their opposite ends for the reception of an electrode wire. These jaws are bowed intermediate their ends. The springing action is obtained by the use of a rocker bar between the jaws. This bar is actuated by the operator by means of a trigger on the handle of the electrode holder.

» «

Arc Welding System

2,253,321. **John H. Blankenbuehler,** Edgewood, Pa., assigned to **Westinghouse Electric & Mfg. Co.,** of Pennsylvania. Filed June 24, 1938. Issued Aug. 19, 1941. A simple and effective manner for automatically feeding a fusible electrode in an automatic alternating-current arc welding system is shown. Control of the value and direction of potential applied to the armature of a direct current electrode feed motor is provided so as to effect feed of the electrode in accordance with variations in the alternating-current arc voltage and maintain the electrode in a predetermined operating relation with work upon which a welding operation is being performed.

» «

Automatic Welding Head

2,253,366. **John H. Deppeler,** Weehawken, N. J., assigned to **Metal & Thermit Corp.,** New York, N. Y. Filed Dec. 13, 1939. Issued Aug. 19, 1941. The welding head of this patent is used with flux-coated metal electrodes. The head includes at least one endless belt, a plurality of contact bars mounted on the belt provided at one end with cutting sections adapted to form spaced grooves in the coating of an electrode, thereby exposing the metal, and also provided with adjacent contact sections of such size and shape as to fit into the grooves in contact with the electrode metal. The belt is driven at a rate corresponding to the desired rate of feed of the electrode. Mechanism is shown for moving the contact bars longitudinally to force the cutting sections into the electrode coating to form transverse grooves in the coating and to move the contact sections of the bars into the grooves to make contact. Current is supplied to the contact bars while in contact with the electrode.

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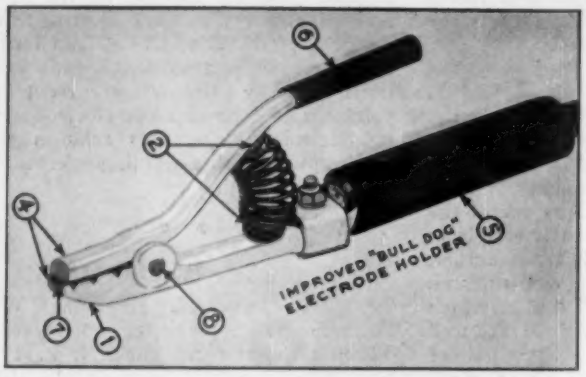

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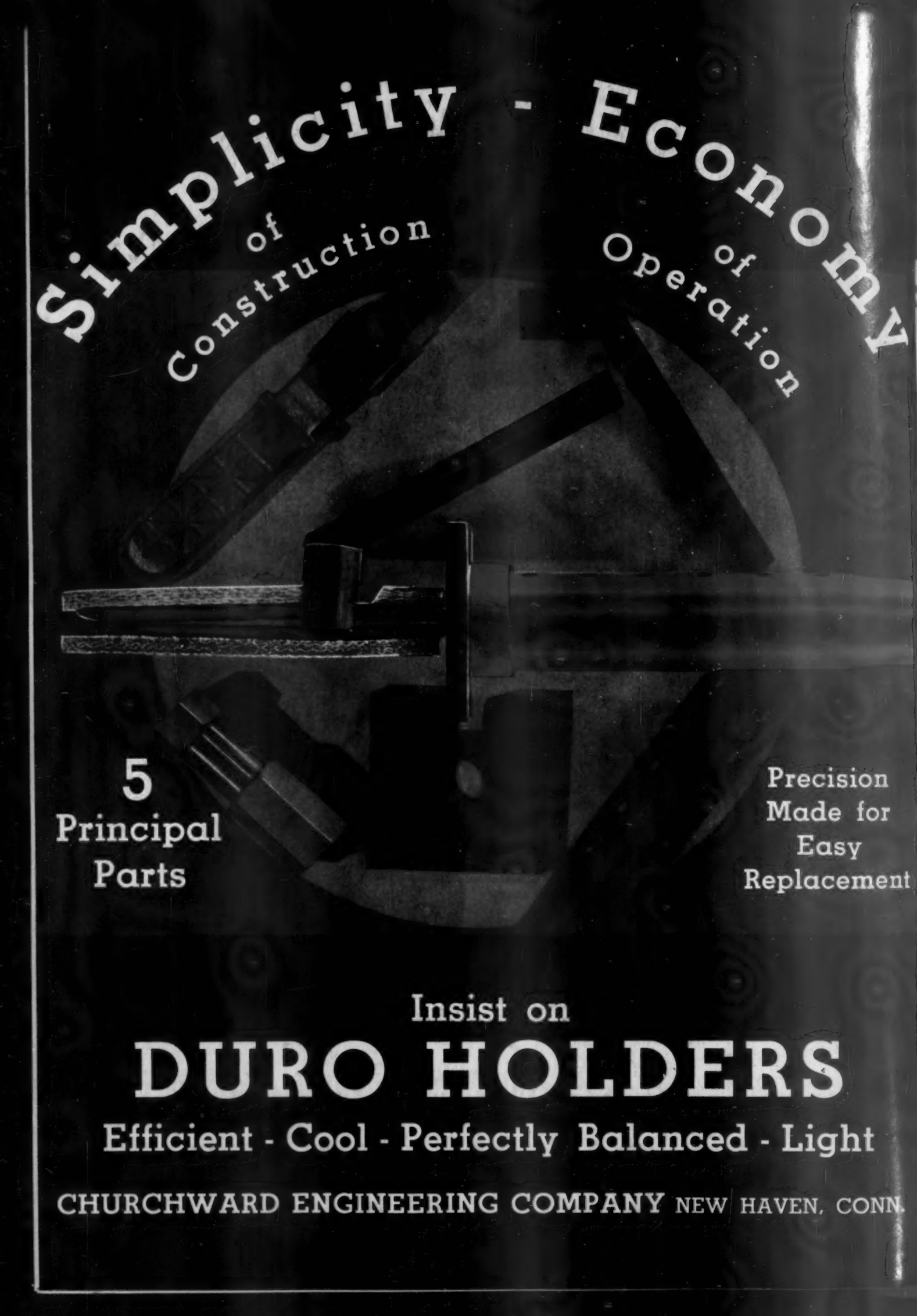
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